INDIAN FISHERIES BULLETIN

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Indian fisheries

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A Small Mechanised Boat

Beam Trawling

INTRODUCTION

Mechanisation of fishing is being given special attention in the country during the last few years. Fishing in Off-Shore and distant waters is being undertaken to explore new fishing grounds and to introduce improved gear so as to increase the range and duration of fishing. Experts under the international co-operation organisations like the F.A.O., T.C.M., I.N.P. are providing technical assistance to the Government in their mechanisation programme. The Government of India in 1957 established the Craft and Gear Wing of the Central Fisheries Technological Research Station, Cochin for conducting systematic research and investigations in fishing Craft and Gear. Since the programme of mechanisation is proceeding at a fast pace in most of the maritime States, the Symposium was arranged to pool the existing knowledge about the improved types of gear that are in use at the different centres.

STATUS OF MECHANISED FISHING IN THE STATES

BOMBAY STATE : Mechanisation in Bombay State has been accomplished by the motorization of the existing boats. The programme has progressed satisfactorily. There are at present more than 1,000 motorized boats.

The motorized boats have extended the range of operation beyond the usual areas. In the case of a boat with motor, she goes as far as 50 miles, while a non-motorized boat do not go beyond 15 miles. A motorized craft go for fishing on an average of 24 days in a month as against 15 to 18 days by the other. The sail boat can use only 70 gill nets at a time whereas a motorized craft operates 100 to 125 nets. Consequent to this greater fishing effort and larger area of operation, the production of fish has also increased by about 50 to 60 per cent. The method of fishing employed is the same in both the motorized and non-motorized boats.

MYSORE STATE : The boats used at present for mechanised fishing are the 24 ft. and 31 ft. "Pablo" designs. Motorization of the dug out canoe was also attempted on an experimental basis with certain degree of success.

There is already a State owned boat building yard at Mangalore and a second one is to be established at Karwar. There is also the programme of training fishermen in mechanised fishing. Small boat trawling for shrimps is now a common fishing method in Mangalore area. Purse seining will also be attempted on an experimental scale.

KERALA STATE : In the field of mechanisation, considerable work has been done by the Indo-Norwegian Project, the Government of India and the State Fishery Department. The State Government has organised two training centres for training of fishermen in the use of mechanised boats and operation of improved types of gear. These centres are in addition to the training courses conducted by the Indo-Norwegian Project.

The most important problem is one relating to fishing population. There is the necessity of evolution of small craft and small gear for small groups or individual fishermen on the one hand and large craft and large gear for big co-operatives or fishing companies, both of which have to be operated simultaneously and without interfering with one another.

MADRAS STATE : Mechanisation of fishing has been given a place of eminence in the fishery development programme of the State. Two training centres are being run by the State Government for training fishermen in mechanised fishing.

The State is experimenting introduction of mechanised fishing with small boats. The boats in operation are 24 ft., 30 ft. and 31 ft. "Pablo" designs. Experiments for the motorization of the Tuticorin type fishing boat have also been attempted.

The State has been interested in the Surf boat development work to replace the beach landing Catamaran. Considerable investigations and trials have also been done in this field.

ANDHRA STATE : Motorization of fishing boats in Andhra was started under the recommendations of the F.A.O. Naval Architect. Fortunately the local boats have been found to be suitable for fitting with engines. There are at present 20 motorized boats.

Nylon gill nets have been found to be the suitable gear. There is a great demand at many centres for motorized boats and nylon gill nets.

A training centre has also been organised in the State to train fishermen in mechanised fishing.

ORISSA STATE : Very little work has been done as regards mechanisation. Three Danish boats are in operation on an experimental basis.

VIEWS OF EXPERTS

F.A.O.

Dr. H. Miyamoto (Gear Technologist)

Reviewing the present production of fish in India and the initial field survey conducted, he expressed the opinion that the vast aquatic resources are not fully exploited. Although the amount of these resources cannot be estimated, the fishing method, if improved on modern lines, can increase the catches several fold. There are two ways of improving the catches of fish; one by mechanisation of fishing crafts and the other by the modernising the fishing gear. Mechanisation of fishing boat although is an important step in the development of fisheries, unless the gears are also improved, the catches may not be commensurate with the capital investment and other recurring charges. On the other hand, if fishing gears are improved on modern lines, the fishermen can increase the catches even if they use only a non-mechanised boat. Modernization of fishing gear and methods should be the first step.

Mr. G. S. Illugason (Fishery Engineer)

The coast from Calingapatam in Andhra up to Karwar in Mysore have been covered trying bottom set nets, drift nets, trawling and also other types to some extent. Small boat trawling is the easiest and the economical method to be introduced. Purse seining for Mackerel and Sardines will also be useful on the West Coast. Nylon gill net is an expensive gear as the synthetic yarn is really costly and the material is also not readily available in India. Although no exact data is available about the life of the nets, the nylon nets used by him stood only for four years.

If trawling is to be done, which is easier and more economical method, the following two facts have to be given due weight and consideration. (1) The current velocity and (2) the power of the engine. Small boats like 22 ft. Danish boats used by him are not what are required in the future. Again trawling from small boats of 10 H.P. can hardly be taken up on the East coast, because current is strong on that coast. The size of the boat for the East coast for effective trawling would be not less than 32 ft. and provided with 30 to 40 H.P. engine.

Mr. P. B. Ziener (Naval Architect)

Most of the coast line was visited during the initial part of the assignment in India. Many Indian boats with certain modifications could be mechanised. To a certain degree, this was also being done with varying degrees of success. The fishing boat development should be linked up with certain areas of the coast and the States who have nominated trainees for the designers course, even though the trained personnel are not full fledged designers, they could suitably modify these existing boats with the assistance of the Experts.

Mr. George Mackenzie (Fleet Manager)

The most important aspect is the actual training of the fishermen and the crew. The present course of six months should be increased to one year. Unfortunately the engineering aspect is somewhat neglected in this course. There should be a course specially for engineering and that would turn out to be the first essential step towards mechanisation. Each State should have their own workshops and dry dock and repairs should be done by themselves as this would prove to be more quick and more economical.

Mr. Peter Gurtner (Naval Architect)

It would be possible within the next few years to introduce very efficient boats designed in India and built in India. There is also the possibility of the manufacture of the necessary engines in India as well as materials for fishing gear. Self-sufficiency in boats, engines and gears are absolutely necessary.

INDO-NORWEGIAN PROJECT

Mr. T. Aas (Project Director)

The project has finished 67 Nos. of 22 ft. motorized boats and distributed to 250 fishermen. According to the statistics and technical investigations, these boats bring in very good returns to the fishermen. The modern gear have been found to be better than indigenous ones. The project has also a research vessel of 67 ft. to be replaced by one of 80 ft. to 90 ft. A 35 ft. fishing boat using different types of gear have given very encouraging results. The project has also a 22 H.P. boat for trails during the coming year.

Mr. Larsen (Fleet Manager)

The five medium boats stationed at Cochin are giving good results. He felt that the quantities of fish landed would be substantially increased in the future.

T.C.M.

Mr. L. Burroughs

It is necessary to improve the indigenous fibres before taking to nylon and other synthetics for all types of fishing gear. Nylon is no doubt good, but it is expensive. All fishing gear in India should be made of a material that is produced in India and is readily available to fishermen.

Mr. C. Kauffman

Specific emphasis should be given to the H.P. of a boat. 50 to 80 H.P. would be the requirements of fishing boats in the immediate future.

———

FISHING BOAT DEVELOPMENT IN INDIA

By

Peter Gurtner

Wherever fishing is a profession on our globe, a considerable number of fishermen will be engaged in catching fish from small boats. It would be wrong to suppose that small boat fishing is a thing to be found only in hitherto underdeveloped areas of the world. Even in countries with tremendously developed deep sea fishing fleets, a good portion of the yearly catch is landed from small boats.

For the purpose of this treatise a small boat is thought to be an open, partly or fully decked boat of about up to 40 ft. length overall. This is a very arbitrary definition. but we must draw a line somewhere, and might as well do it where it is sensible for India as a whole.

While most countries have considerably profited from recent research and applied science in the field of naval architecture, and have utilised such scientific knowledge to improve their deep sea fishing fleets, the same may unfortunately not be supposed of small boat fleets. Some eminent authorities on fishing boat design, such as Mr. J. O. Traung, Chief of the Fishing Boat Section of the Food and Agriculture Organisation of the United Nations (F.A.O.), are of the opinion, that most of the European small and medium fishing boats show a deplorable lack of modernity and efficiency, meaning, that in general their hull shape does not, or only partly, conform with the latest knowledge. Nevertheless, the boats use up to date gear and fishing methods, thus reducing the losses attributable to wrong design in the first instance.

Small fishing boats are very rarely designed by Naval Architects, and more rarely by Fishing Boat Naval Architects still. The boat building industry in most parts of the world, apart from the pleasure boat industry, is a very conservative trade indeed, and much of its activity may still be summed up by saying : What was good enough for Grandfather, is good enough for me !

Since 1950 about, interest in the development of small boats has grown very much everywhere, and the biggest milestone in this forward path so far was the 1953 FAO World Fishing Boat Congress in Paris and Miami. This congress has for the first time pooled the knowledge of top notch Naval Architects and Fishing Boat Designers from all over the world, and its proceedings, the well known book "Fishing Boats of the World" can justly be regarded as the most up to date reference book on fishing boat design.

Since the 1953 Congress, the Fishing Boat Section of F.A.O. has become more and more important as a clearing house for new development ideas and results, and can also credit itself with quite a few major development projects of its own. It is most gratifying to know that F.A.O. is again organising an international congress on fishing boat design, to be held this time in Rome, Italy, in April 1959. No doubt the proceedings of this second congress will show the tremendous advances in the field of small boat design.

Making the same mistakes as in other countries all over again must be avoided here, but fullest recognition of the new and advanced knowledge about small boats and utilisation of such knowledge for the development of a small boat fishing fleet should be endeavoured.

For this India is singularily well placed, as there is not yet a noticeable tradition in the design and building of small boats, and new and newest ideas may well be introduced here without too much resistance.

However, it must be clearly understood that even the best and most forward ideas have to be fitted into the overall speed of advance of the development. It would be outright foolish at present, to go too far and introduce boats of too big a size or too complex a build-up, before a large slice of the fishing population has attained a better financial base by using simple, small, fully mechanized boats.

The following attempts to give a general idea of how a Naval Architect sees the development of fishing boats in India, and how he assesses his contribution to this end.

Background

For the full understanding of the present and future development, it is felt necessary to give a short account of the history of mechanized fishing boats in India. This may conveniently be split up in a "Base situation and 4 Development Stages" treating the problem of a suitable Surf-Beach-Landing craft separately. Thus we would have :

Base	Country Craft.
1st stage	Mechanisation of Country Craft.
2nd stage	Introduction of simple, small mechanised boats.
3rd stage	Introduction of bigger, more specialised boats.
4th stage	Broadening into fishing fleets.
Separately	Development of Surf-Beach-Landing craft.

Base—At the outset of any development, we will have to assess the resources the case history and the boat types of India. Such an assessment has been carried out by many people, consciously and unconsciously, by Historians, primarily interested in boat types of a certain locality, by marine Archaeologists mainly interested in the history of boats in general, later by people connected with shipping and commerce, or by people with a love for boats, ships and anything that has to do with the sea. All these have greatly contributed to our knowledge of the various boat types and their history. The next step, the assessment of the value of these boat types for fishing with modern gear, had to be left to the experienced Naval Architect, however, and we owe a lot to Mr. P. B. Ziener, the first F.A.O. Naval Architect in India, for the work he carried out in this respect.

1. *Mechanisation of suitable Country Craft*

This is the logical step in the development after the base establishment. We should realise right away that the more introduction of engine power to supplement such original power sources as wind and man power, does not in itself guarantee a more efficient fleet of fishing boats, or in other words, greatly increased catches. While engines make a fishing fleet independent of wind and weather to a great extent, they are rather expensive items of equipment. Fishing from mechanized country craft must then yield more profit than the mere independence from wind and weather, and the somewhat enlarged radius of action would result in. This will be brought about only by the introduction of advanced methods of fishing and modern gear, such as nylon nets, trawls, purse seines, floating long lines, trolling and the like. We may safely state that the mechanisation of certain types of country craft, together with the introduction of modern gear and methods, has proved the validity of these statements during the last few years, and has also established the need for mechanised boats as such.

As a complementary statement, we may assume that mechanisation has by necessity to be restricted to the most suitable country craft, and that catamarans and dug outs are normally to be treated with reserve.

The development has now almost outgrown this stage and has given way to the implementation of stage 2 and in some instances even stage 3.

2. *The introduction of small, open, mechanised fishing boats*

It is by no means the scope of this paper to give a detailed historical account of how this stage has been brought about and implemented, but a few words must be said to connect it logically to further stages of development.

Two lines of action suggested themselves when this stage was tackled :

We could introduce completely new types of boats, and

We could develop certain suitable types of country craft into fully mechanised boats.

Both lines of action have been followed in India with gratifying results. While the development of suitable country craft has resulted in a great increase of confidence within the fisherman communities in these new tools of their trade, the introduction of new types of boats, first in selected places, then almost Nation wide, has shown clearly that such new types are also readily accepted by the fishermen. Through this double action, and its success, we have gained confidence in our idea that the fishermen in India are ready to accept almost anything that proves to be better than what they had before. This sounds very obvious, but unfortunately it is not so. Fishermen are usually very conservative, and it takes a lot of arguing to coax them into trying new ideas. This is an understandable attitude, because fishing is a very hard profession, and it not always provides the minimum means of subsistence. The fishermen will normally be sceptical to experiment; he will stick to what he knows will be sufficient to guarantee his livelihood. We will find this attitude of fisherfolk all over the world, although, in most countries, they are increasingly turning to the scientist and technologist to provide them with new ideas.

A multitude of country craft has been redesigned in India by the F.A.O. Naval Architects, Mr. P. B. Ziener and Mr. K. K. Rasmussen, and many of their assistants and counterparts have made successful attempts in this direction also. No doubt this work will have to continue for some years to come in specially favoured areas, where suitable types of country craft are found.

New types of fishing boats have also been introduced in the last years in great numbers by many organisations and individuals. It may sound presumptuous, if we say here, that the efforts of F.A.O. in this direction have been particularly successful, without wanting to diminish the merit that has to go to other sources. The reason for this success is probably that the F.A.O. men engaged in this work have realised from the outset that development must be gradual, and that it is above all the individual fisherman who must be helped before an acute "engine sense" could be developed throughout the country. And at this stage the fisherman could only be helped by giving him a small, simple, not too costly boat to work with.

Not least, the success is also due to the understanding and the good help received from the Governments of the Maritime States and from Central Government in Delhi.

This particular development stage will go on for some time, indeed probably for ever; but it has opened the door for a wider development and has given us certain pointers how to proceed with the next stage. This last result we consider to be the most remarkable outcome of the second stage.

3. *Introduction of bigger, more specialised boats*

It was only a matter of time, till those who attained greater income with the small boats started crying for bigger boats, more powerful boats, boats with more catching capacity and consequently earning capacity.

Parallel with this growing interest for bigger boats was the increased activity of various fishermen's organisations, to help the individual in getting a mechanised boat,

or to start ownership on a co-operative basis. Fishing grew from a Trade into an important Industry and more and more ancillary industries started to get interested in it or grew sensitive to its development. To name but a few closely connected industries, freezing and canning plants were started to deal specifically with fish, and luckily, even the manufacturers of stationary diesel engines in India as well as many general engineering works are now getting increasingly interested in the fishing industry.

The industry has attracted the interest of all sorts of business circles and it is fastly growing very complex. More varied groups than only fishermen's societies are getting interested in owning their own fishing fleets and we may say that the era of the commercial fishing fleet is about to start in India.

We may safely suppose that these future owners of fishing vessels will have much bigger financial resources at their disposal than the individual fishermen; the same holds undoubtedly true in the cases where the Governments show an active interest in fleet ownership.

To cater for the needs of thus expanding and newly forming interest the Naval Architects will have to begin introducing bigger vessels, at times getting outside our definition of small boats. We must do this; but we should not at any time forget the needs of the fisherman proper and the present and future small boat owners. Should we forget them, and solely concentrate on the "Big Business", we would rob the industry of its natural base; should we decline to advise the "Big Business" in matters relating to boats, and solely concentrate on the needs of the individual, we would sooner or later loose the interest of many of these new backers and financiers of the expanding industry due to lack of scope, and thus we would come back many steps in the development.

It is evident that we shall have to split our efforts in order to satisfy the demands of two groups of equal interest but very different needs. This development stage is apparent in many places today, and, if all goes well, we shall soon have to deal with the 4th stage in selected places.

Today—Tomorrow

The size and type of boat to be used will generally be determined by the four major factors :

(*a*) The economic standard of fisherman, or, in other words, his financial possibilities. Various Government schemes for helping the fisherman to obtain better boats will have to be considered here (this includes in a broader sense of the world 'fisherman' the commercial fishing enterprises).

(*b*) Considerations relating to marketing and distribution facilities.

(*c*) The fishing method to be used on the boat, or the combination of methods endeavoured; this is closely connected with considerations of a geographical nature—locality of use of the boat.

(*d*) The application of latest research results and best possible blending of theoretical and practical Naval Architecture and Gear Technology.

Although hardly within the scope of this paper, we must briefly deal with (*a*) and (*b*) to show how they are connected with the more technical aspects of the problem at hand :—

(*a*) The economic standard of the fisherman is probably the most limiting factor in all development schemes, not only in India, but in many countries in East and West. It is readily understood that without outside help, the individual fisherman and many a fishing enterprise are not in a position to make use of the latest technical developments, be it in the field

of boat design and construction, or fishing gear and such related things as electronic devices. The success of any development programme is therefore largely dependent upon the measures introduced by Government to effectively help the fisherman.

(*b*) Further considerations of an economic nature should help to direct efforts to introduce mechanized fishing boats. These pertain to the question of adequate markets and distribution centres for the catch, and while not strictly in the realm of the Naval Architect and Boat Designer, he should nevertheless have an idea of their importance and should also follow possible schemes designed to eliminate obstacles in this particular line.

Again we can say that the industry would be badly served, should we insist on introducing craft of such a size or catching capacity, that existing markets would not be able to absorb the catches, and existing distribution chains and processing facilities would be overflowed with surplus catches.

(*c*) To get an idea of the problems encountered when dealing with these questions, we must briefly mention the principal fishing methods at present in use in India and those to be expected for the near future.

Fishing with various types of nets has been going on in India as elsewhere for uncounted years. But the fairly recent accent on modern development has brought a few well suited methods into the foreground and it may be expected that in due course even other modern methods will be adopted by Indian fishermen with excellent results.

The most widely used method is probably today fishing with set nets (Gill nets), be it drift nets or bottom set nets. Both types of nets require basically the same type of boat. This fishery is done to advantage also from unmechanised country craft such as Catamarans and Dug Outs, but their carrying capacity is very limited. Mechanised country craft, and the new, small, open, mechanised boats of recent design and construction are mainly using these methods with great success.

Trawling, mostly for shrimp, has been tried in various localities all around the coast of India and is probably now on the way of becoming a major method, at least in the North-East regions and all along the West Coast. While most trawling is done with the so called Otter Trawl, some experiments have been carried out, and are still continuing, with the Two Boat or Bull Trawl.

Otter trawling is carried out both over the side and over the stern of the boat, each way necessitating special features in the layout of the vessel. Stern trawling seems to be the easier method with the comparatively small nets used, and provided the fishermen are instructed by experts thoroughly acquainted with the method, it should also prove to be the easier to learn. Most boats at present trawling in India do so over the stern. In this connection it may be of interest to learn that many experts believe that stern trawling will eventually replace side trawling even in such conservative fisheries as the European, and it may be noted that practically all shrimp trawling in the United States is done over the stern.

It is not our intention to discuss the merits of various ways of doing the same thing; this must be left to the fisheries experts to decide, although it should be a good idea to call in the Naval Architect when deciding on what to adopt. Purse Seining has been tried in India in some places with quite good results. No doubt the near future will bring greater efforts to find out whether this method holds any scope for India. It is a method that requires an extremely skilled skipper who can well judge the concentrations of fish and let the net go in exactly the right moment. The Purse

Seine net is mainly used to catch shoaling fish, such as Sardines and Mackerel, but the possibility of fishing for Tuna with it in the future should not be overlooked.

Less importance for the Indian fishery scene might be ascribed to the Danish Seine although it should of course also be tried extensively. It is a method that is widely used in Northern Europe and in U.K., and again its success depends very much on the judgement of the skipper.

Other methods that will no doubt be tried and might offer some scope for specialised fisheries are lift netting, Lampara net fishing, floating trawls etc. However, one or the other boat equipped for some related method may no doubt also be used for these.

Long Line fishing has already been tried with good success and will certainly remain here.

Again it should be borne in mind that the future will probably bring a much extended fishery for Tuna, perhaps very far offshore, and long lining will be a very important method then.

Hand Lining would also appear to be a method worth while trying for various species of fish.

Line fishing methods that have become very important in other parts of the world, like Pole and Line and Trolling do most probably also offer scope in India, and it will be most interesting to follow experiments in that line to assess the necessity of developing special boats for these methods.

There is a great multitude of fishing method that will be used in the future, and similarily there will be many different boats for most efficient use of these methods. However, several methods of a related nature may later be grouped together and used from one and the same boat, which will have to be designed as also called combination boat. Most fishing methods are of a seasonal nature, and in order to utilise a boat all the year round, other methods should be used to advantage in the off season for the main method.

We should realise also in this connection, that so far, with very few exceptions, only inshore fishing has been commercially practised in India. The future might show that rich fishing grounds are to be found very much further offshore, be it right out to the edge of the continental shelf or even further out in the case of Tuna. We will then most probably see an expansion of fisheries also in terms of radius of action and time spent at sea. For offshore fishing, it will no longer be possible to return to the base every night, but the boats will have to stay out for several days and nights until they are full to capacity. This will of course mean bigger boats, which in turn means more engine power, more complex equipment and arrangements for the crew to live reasonably comfortable for some time on board.

(*d*) Small boat design, and in particular fishing boat design, has long been a neglected side line of what is commonly known as Naval Architecture. This is perhaps illustrated by the fact that only in very few institutions is it at all possible to study this particular subject, while there exist a multitude of Universities and Colleges running regular courses in big ship Naval Architecture.

Since the last war, a tremendous amount of original and applied research work has been conducted into the properties of small boats, often with a direct bearing to military or naval application of the results. To our great benefit, it was soon found that much of the originally purely military or naval research could also be applied to fishing boats. Research subjects

of particular interest to the fishing boat designer are the following, among many more :

Tank Testing in general, including the accurate prediction of resistance of boats, their power requirements, their behaviour in waves of various patterns and shapes, propulsion of boats with sub-headings propeller study and interacrion ship—propeller, accurate analysis of various form properties on the performance of boats, resistance measurement of trawl nets and other fishing gear.

Research into the sea-keeping qualities of boats.

Stability of fishing boats; this leading to very useful theories and criteria regarding minimum stability conditions for fishing boats.

Application of big ship research to fishing boats, such as the possibility of using bulbous bows on trawlers.

Universally applicable minimum scantling rules for wooden boats (should result in great savings in initial cost).

We must clearly realise in the face of all new knowledge that is almost daily appearing, that development will never come to a stand-still.

Having realised this, we will not have difficulties to be true to ourselves and to admit that there is no such thing as the "Ideal Boat," unless by that term we clearly understand the boat that best conforms to the knowledge of one particular moment. The next moment will most probably change our ideas on certain points, and we shall want to change out "Ideal Boat" of yesterday, to bring it in line with today. It is a vexing circle, but we must realise it and never be content, but always try to improve upon our work of yesterday !

Similarly the Naval Architect engaged in fishing boat design has a duty to keep himself abreast of new developments in the fishing gear sector. It is the fishing gear that makes the tool of the fisherman out of his boat, and any fishing boat designer should know sufficiently well what is afoot in this line, to be able to determine how and where on his boat the gear is best going to be utilised. He will have to go to sea and observe the boats, the gear and the men working it to do his job well and with authority. Only thus, and through continuous study of new developments will he be able to decide on the best possible arrangement for his boat.

It is futile to give a complete list of all the things a Naval Architect must consider and weigh against each other to arrive at the final compromise any fishing boat represents. Instead we should now proceed to indicate briefly what we feel the main types of boats to be introduced in the near and more distant future should be like. It is hoped that this will provoke animated discussion, because the best possible boats will come out of the synthesis of opinions of various people.

The Boats

It must again be stressed that every fishing boat represents a compromise, arrived at by carefully weighing against each others the different factors that influence its appearance, but before all, always trying to produce the maximum efficient tool for the fisherman.

The designer is often at a loss to decide where, and how much, he may depart from the best possible solution to one part of the complex problem; but not forgetting that he has to produce a good working platform before all, the choice is at times made a bit easier. However, it must be said with a tear in the eye, that he is very often forced to depart from what he considers the best compromise by sheer obstinacy on the part of the future owner of the boat.

Any compromise is open to discussion, and we should not want it otherwise; we like to discuss the advantages and disadvantages of various way of doing the same thing, and of course we learn constantly.

Gill-net Boats

From the designers point of view, it is fairly easy to satisfy the demands made for a good gill-net boat.

The fishing method consists principally in shooting a long chain of nets, usually from the aft quarter of the boat (in certain American types over the stern, when the nets are stored on a big drum on the aft deck), leaving the nets floating at the surface or anchored to the bottom, depending on the type of fish sought; after some time the nets are hauled, one by one, usually over the forward quarter of the boat. The fish is caught in these nets by getting its gills entangled in the meshes.

The size of boat to be adopted for this fishery will depend largely on the number of nets to be carried. As gill-net fishing is still used by most catamarans and dug outs in India, it is evident, that any boat working this method in the same area as the country craft will have to carry substantialy more nets than they do, to be considered an economical improvement.

It is thought that a boat of 25 ft. length should carry at least 15 nets, one of 30 ft. some 20—25 nets and correspondingly more nets for still larger boats. Modern boats used for this fishery are mainly the well known "Pablo" type boats of 24 ft. 7 in. length and the bigger 30 ft. types. Unfortunately these boats seldom carry the optimum number of nets. This deplorable fact may stem from a simple economic reason. Modern nets are expensive, and the favoured nylon gill-nets are still in very short supply. The distribution of these nets is often directed by the State Department of Fisheries. In one Maritime State at least, the small "Pablo" boats were normally issued 9 nets, while the bigger 30 footers only got 11 nets. It is of course obvious that boats under these circumstances were not utilised to capacity, and yet they proved to be successful !

A new type of 25 ft. boat with a transom stern is now being introduced and some boats are building at this time. It is hoped that a bigger number of nets will be made available for these boats, as they promise to have a rather increased capacity over the "Pablo" boat.

We feel that the 30 ft. boat will be sufficiently large for some time to come, where a bigger boat for this method is required. There does not seem to be an immediate need for a still bigger design.

The layout favoured for a pure gill net boat is rather simple. As big a working cockpit as possible, arranged forward, where nets and catch can be stored, and from where nets are shot and hauled, is the essential requirement. If possible, it will be advisable to instal a mechanical net winch or line hauler in the forward part of this cockpit, to speed up hauling of the nets and to simplify the work. The steering position is conveniently arranged far aft, and the engine may easily be placed aft, in the best position from the performance point of view. At one time it was thought to be necessary to instal a net chute, but as the fishermen hardly ever use it properly, it seems to be unnecessary and may be omitted, at least in small boats.

Power requirements for this fishery are very modest; 10—15 H.P. will be enough for the smaller boats and about 20 H.P. should be sufficient for the bigger ones. The reason for this low power requirement is the fact that the actual fishing operation is performed from a static boat, and power is only necessary to propel the boat to and from the fishing grounds.

It is advisable to equip all small gill net boats with a workable sail. The boats are of a size and shape to which a good wind and a good sail plan will give almost

the same speed as the engine, and it is readily seen that under favourable wind conditions great savings in fuel could be made.

Trawlers

Trawling is still a fairly new, and not well established fishing method in India. It might be argued that it is still too early to discuss the type and size of vessel to serve for the purpose in the immediate future and for many years to come. Trawling has however, been tried from a multitude of different ships, most of which were not specifically designed for the job. We feel therefore that the time has come to introduce the design for a medium size trawler that could be used to advantage in the near future, and we also think that it would be time well spent to start considering bigger ships for the future. The most profitable trawling grounds have most likely not been exploited so far, but trawling was rather restricted to areas very near the coast due to the size of the boats used and their limited power. We should not forget that the depth to which a trawler may successfully drag its net is largely subject to the power available. If trawling is to expand to deeper waters; we will have to get more powerful engines into the boats, bigger boats at that.

The type of trawler we have in mind for immediate use may perhaps be illustrated by the design for a 32 ft. trawler recently completed; a number of boats are at present building to this design already.

Profitable stern trawling calls for a vessel with a considerable hold capacity, and a sizeable working deck aft to handle the net and sort out the catch. Keeping this in mind, the designer is above all faced with the problem of placing the engine. From the fishing point of view, the engine would best be placed far forward, leaving the aft part of the ship free from obstructions, and the middle body for the fish hold. From a strictly performance point of view, the engine should be as far aft as possible. Such a position would reduce the working deck area very much through trunking over the engine in very small boats. However, in the boat in question, it was felt that the engine could be put fairly far aft without reducing the working deck too much, leaving the middle and fore part of the ship for fish hold and steering position. The engine then is readily accessible, the winch can be put in its logical place with very short power transmission necesary, the fish hold is adequate, and the steering and control position is sufficiently far forward not to interfere with the fishing operations.

In any smaller boat however, it would be necessary to move the engine further forward to gain deck space.

Engines very far forward bring certain distinct disadvantages. The lines of the boat must be made much fuller forward than would be advisable for top performance, this fact also increasing the prismatic co-efficient over its optimal value of around 0.575. Furthermore, a very long propeller shaft will have to be accommodated, running through the hold. Long shafts are much more liable to mis-alignment in a wooden boat, and the fact that they would have to be covered in the hold, taking away valuable cubic footage, should not be overlooked either.

Power requirements for trawling are considerably greater than for gill net fishing. A trawler may be imagined as a sort of a tug, towing a net instead of barges or other floating vessels. This towing is done at greatly reduced speed, but with, if possible, maximum power output of the engine to overcome the resistance of the towed body. In the case of trawling, the towing resistance of the net and the long warps attaching it to the ships, as well as of the otter boards, greatly increases with increasing trawling depth. It is then readily seen that a low powered trawler is greatly reduced in effectiveness as far as trawling at greater depth is concerned. Most trawling so far has been done with between 10 and 30 H.P. in depths between 6 and 15 fathoms. Any serious attempt to trawl in deeper water will necessitate more power.

The 32 ft. trawler discussed here, should, if possible, be equipped with an engine of at least 36—40 H.P.

Selection of propellers is of utmost importance to ensure an efficient trawler Biggest possible propeller diameters should be endeavoured, with correspondingly low r.p.m. of the engine, relatively low pitch, resulting in maximum thrust. It is felt that many of the small boats at present trawling on the West Coast (especially those with 10—15 H.P. engines) are equipped with the wrong propellers. Mostly these propellers have definitely too much pitch and are run too fast, this resulting in serious cavitation and spoiling of the propeller. Slow running diesel engines and controllable pitch propeller gear are especially suited for trawling, while medium and high speed diesels must be provided with reduction gears, giving slow shaft r.p.m. and allowing the use of big propeller diameters.

Trawling gear on the vessel under discussion consists of a small trawl winch, trawl galows, aft, a stern roller and a mast and lifting tackle.

The winch should have a drum capacity of at least 120 fathoms.

Trawl galows should not be fitted at the extreme aft end, but somewhat towards the midlde on either side, thus reducing the steerage effect when turning. It seems to be better to have gallows on either side than trawling from one point on the stern. The distance between the galows insures an initial opening of net, and collapsing nets due to intangled wires and boards occur less frequently. The stern roller is used both for shooting the net and for hauling it. During all operations the boat should maintain forward motion to make it impossible for the net to foul the propeller.

Further deck equipment would consist of permanent awning posts (they should be specified on all small boats) and possibly a small wheelhouse.

Strictly speaking a small boat can easily be steered and controlled from an open control position; but it is often handy to have some shelter from the helmsman during bad weather and rain.

With the likely future extension of trawling operations to deeper waters, a new type of vessel will have to be introduced—the long range trawler. While discussions on this type of vessel will probably start soon, it is still too early now to illustrate with any claim to accuracy what it will look like. Many points will have to be considered and clarified, and above all, deep water trawling must first be proved to be an economical operation, and profitable trawling grounds will have to be mapped out carefully.

Purse Seiners

As likely as not, purse seining will develop into an important fishing in India also. The boats to be adopted for this would probably closely follow the American pattern, *i.e.* they would be very similar to the stern trawlers, with a large, clear, aft deck, with fish hold under, engines amidships and accommodation forward.

The Purse Seine, a very big and bulky ring net, is shot over the stern in a circle around the shoal of fish to be caught. When the circle is closed, the net is quickly closed at the bottom, pursed, an operation which is normally done with the help of a small winch or gurdy, as it has to be done very fast to prevent the fish from escaping. The net is then recovered over the side of the boat till it encircles the fish as a practically solid mass. The catch is then bailed into the ship with small net bags, sorted, boxed and iced, to be stowed in the hold immediately.

It seems advisable to give these ships fairly low freeboard aft; this measure will ease the heavy work of recovering the net over the side, and will also help to keep stability at a reasonable value when the heavy net is stowed on the aft deck.

In small boats, this will make it necessary to raise the deck level over the hold to provide the capacity needed to stowe the catch.

An arrangement drawing of the 32 ft. boat discussed above, laid out as a purse seiner, is under consideration and will be released shortly.

Combination Boats

Trawler—Drifter

Very often it may be desirable to arrange a boat as a combination tool for more than one fishing method.

Two main question then have to be clearly answered before a decision as to the layout of the boat is taken :

Which of the method to be adopted is the main one, and which secondary, and

Is the secondary method at all a complementary one in the region concerned?

Obviously the more important of the methods will determine the main features of the boats layout and any secondary method must be fitted in as well as possible. It would of course be useless to equip a trawler also as a drifter, if in its area of operation no profitable drifting may be expected.

A good compromise is normally possible in this case, as we have seen that stern trawling mainly utilises the aft part of the ship, and drifting the forward part. However, we are faced with the difficulty of positioning the engine and the controls so that they don't interfere with any of the methods. Both positions far aft and far forward are out of the question, as they would interfere with the working arrangement of the boat, and some position amidships, or nearly so, will have to be adopted for both.

Obviously more compromises will have to be made in the case of a combination boat, and she will most likely be neither a 100% efficient trawler nor a 100% efficient drifter. But the fact that under good circumstances the boat may now be utilised throughout the year for whatever methods is the most promising at a time, will probably insure an increase in the total earnings over a purely seasonal boats.

Trawler—Purse Seiner

As the above mentioned requirements suggest, these two methods can easily be combined in one boat, always provided that the two fundamental questions are carefully answered.

A trawler may be provided with removable trawling gear; when substituted by the pursuing gear, the trawler is transformed into a purse seiner. In fact very many of the American Seiners are laid out as combination boats in that way; often they are even equiped with a combination trawl-purse seine winch, thus only necessitating removable galows to change from one method to the other. Needless to say that such ships are very versatile and most economical tools.

Such ships will have a future in India too, when trawling and purse seining become increasingly important.

Combination arrangements for the 32 ft. boat are now being finalised, and will be distributed soon to interested parties for trials.

Line Fishing Boats

Long Lining and Hand Lining do not tax the designers imagination and skill to a very great extent. They are methods that could be utilised to good advantage from many types of boats wtih a variety of arrangements.

It should be borne in mind however, that they are methods brought to perfection mainly by the Japanese, and before thinking of their introduction in future Indian Fisheries it would seem to be advisable to avail oneself of the available know how and experience of the Japanese fishermen and boat designers. This would be particularly important in case it was thought of initiating large scale Long Line Tuna fishing in the Indian Ocean.

Pole and line fishing, as practiced very much on the American West Coast and in the Pacific in general may well be introduced in India too at a later date. Basically a pole and line boat will be somewhat like a stern trawler in appearance, as the fishing is also done from the aft part. Great care must be exercised in giving the boat sufficient stability under all conditions, especially if large bait tanks are to be installed on deck, aft.

An outline design for a 45 ft. pole and line boat is available with F.A.O. and it might well be that this boat could be well used for exploratory fishing for tuna in the near future. The boat was originally designed for use in Haiti, with very similar climatic conditions to South India, and only few changes might be necessary to use the boat here.

Trolling again could be performed with a variety of boats, and it would appear that it should be a good complementary fishing method for many small boats engaged in gill netting.

Training Vessels

While not strictly commercial fishing boats, a word should be added about this very important class of ships.

In India, with many Fishermen Training Centres, it is most desirable that these centres should be equipped with up-to-date boats and gear to teach their pupils effectively the ways of handling modern boats and gear.

Training boats will have to serve a multitude of purposes, from gill net fishing, trawling, purse seining to line fishing, and usually they also have to serve as floating class rooms for teaching navigation and even engine maintenance. While the boats may not be too expensive, and thus have to be of modest dimensions, the designer is forced to arrange them so that optimum space is available for all these activities in perhaps one boat alone.

It should basically be a demonstration boat for various fishing methods. A number of such boats are at present in commission, most of them adapted from designs of small, commercial fishing boats. Some of these boats could easily be improved, to arrange them effectively for an optimum number of different uses.

Research Vessels

These are boats not really to be labelled as fishing boats, yet very closely related to them. They are not only vessels equipped for basic research, Marine Biology, Oceanography and other Marine Sciences, but also ships engaged in experimental and exploratory fishing. For a fastly expanding fishery like the Indian, we should consider the latter two of greatest importance, basic research coming into its own right at a later date. when development slows down and has to be consolidated.

An immense area of sea will have to be covered by exploratory fishing soon, to forecast the possibilities of expanding commercial fishing efforts. Experimental fishing will have to be done over a long period of time with new and newest gear to prove its efficiency and suitability for varied local conditions.

We feel that research vessels, just as fishing boats in general, could and should be developed in India, rather than importing them from outside countries. In many instances imported ships have not been performing the tasks ascribed to them with maximum efficiency; they are very often built of materials that do not stand up well to tropical conditions, and their layout is often not conforming with special Indian requirements.

With the growing of Central Fisheries Technological Research Station, such as the one now operating in Cochin, studies to determine the optimum types of research vessels for various groups of uses could well be carried out in India.

For further guidance, the Fishing Boat Section of F.A.O. has unparalleled experience in that type of ship, and its knowledge is at everybody's disposal. F.A.O. has in recent years collected material on practically all the world's research vessels, and on top of this, the Fishing Boat Section has actually designed research ships for a multitude of countries.

Surf Boat Development

All the aforesaid refers to the development of harbour—or shelter based boats. A significant fact, that may not be overlooked when examining Indian fisheries, is the even distribution over very long stretches of coast line of a big part of her fishing population. These beach fishermen use mainly Catamarans and Dug Outs for their trade, most probably because it was found through age long experience that these were the only craft that could successfully tackle the heavy surf that prevails in these areas. In other words, while other people under more favourable circumstances developed boats, the beach fishermen were beaten by nature and had to stick to the old, primitive craft. This situation is found practically everywhere where heavy surf occurs.

While it should be realised that ultimately the most efficient fishing will be done with craft based in harbours, be they natural or man made, it will also be realised that many years will pass before a sufficient number of specific fishing ports will be found around the coast of India. Thus, for a large proportion of the fishing population, there is no place where they can go and turn to mechanised boats for many years to come, and even if there were, it is questionable whether these new fishing centres could absorb all the beach fishing population.

The people living along the open beaches seem to be left out from the general development, unless modern technology and science can come to their help. The problem of developing a fully mechanised, small, fishing boat for precisely the use of these people has been tackled by many men, for years now.

The solution of the problem is made very difficult by two main factors :

Surf is a very treacherous phenomenon, and a very dangerous one as such, when it reaches the maximum heights that are reported along the coast here. The power of the breaking wave is tremendous, and any boat having to stand up to the inevitable, rough treatment when crossing the surf, must be very strong indeed.

The fact that the boat has to be beached every time she lands, severely restricts the possible size of boat, as it demands a light boat, that can be handled by her crew and possibly a few helpers. We may not, at the beginning, rely on mechanical beaching gear to haul up the boats.

There is no space and time here to relate the full story of this development work, but a few words might explain where we stand today, and what may reasonably be expected for the near future.

The F.A.O. Naval Architects, who have worked on this problem for years, are certain that they have now arrived at basically the right type of boat. A few prototypes of the boat are being continuously tested in India and in West Africa with good success. The present boats however, are conservatively built and very strong, and are generally believed to be too heavy for beach handling by a few men only. They would be, if conservatively built in large numbers, also far too costly. The efforts are now directed to convert the present design into one suitable for mass production methods, employing plywood and possibly resin bonded fibre glass as fastening. Such a boat would be extremely strong, yet very light, and if produced in large numbers (several thousand) very cheap too.

The coming year should, if at all possible, see full scale experiments with a number of such mass produced boats to establish its suitability beyond doubt. We have

to be extremely careful in this programme, because the boat ultimately selected must be rebuilt may be a couple of thousand times, and for such an ambitious programme only the best is good enough. Because of this also, we pray to be excused for not at the present releasing the design to the public.

It is hoped that by this time next year, concrete plans for mass production of the boat will be drawn up, and that early 1960 will see the beginning of greatly improved fishing conditions from the beaches, with a consequent bettering of the standard of living of the beach fishermen.

PROBLEMS OF MECHANIZATION IN BOMBAY STATE

By

S. D. DESHPANDE

Mechanization in Bombay State

Bombay fishermen are the first in India to take to motorization of fishing crafts. Nearly 1,000 fishing crafts have been motorized so far and there is still great demand for engines from the fishermen. The next stage in the field is the introduction of mechanized fishing. With this object in view the first Fishermen Training Centre was established at Satpati. Experiments were also conducted at the Training Centre with differents types of gear and tackle, to study the advantages of the same. A brief account of the local methods of fishing will be interesting before mentioning the results of the experiments conducted at the Centre.

LOCAL FISHING METHODS

Bag-net fishing

The net locally known as "Dol" is operated along the West coast from Harnai to Nawabunder at a depth of 9 to 25 fathoms for catching Bombay ducks, Pomfrets, Prawns etc. It is a conical net of about 180 ft. x 60 ft. size made of cotton yarn and is operated with the help of wooden stakes of "sus" already fixed in the sea bottom. The net is kept open by the tide and the fish is caught simply by filteration of water. Five to six such nets are operated by a mechanized craft.

Bottom-set drift-net fishing

The net locally known as *"Waghara"* is operated for catching Dara, Ghol and Towar etc. and is prepared out of Italian hemp twine. The size of one unit is 6 ft. x 48 ft. or 10 x 142 meshes. The net is shot across the tide, one end of which is free with a flag mark and the other end is tied to the boat. The complete gear with wooden floats and stone sinkers goes to the bottom of the sea and the boat with gear drifts with the tide. 60 to 70 such units are used by a sail boat and 80 to 125 are used by a mechanized boat. This type of fishing is conducted north of Arnala to Daman and also in Jamnagar areas, at a depth of 16 to 25 fathoms.

EXPERIMENTS CONDUCTED AT THE TRAINING CENTRE

Bottom-set gill-net fishing

This method has not proved to be a success in this area due to the strong tidal current (4½ to 6 knots); the grounds are very soft and as such the net closes and fails to fish. Experiments were conducted with 400 to 150 fathoms of netting and it was observed that even in case of 150 fathoms of netting the fishing operations were not successful due to the above-mentioned difficulties. The strong bottom current might be responsible for this.

The local fishing method was also tried and the catches were comparatively better in the bottom-set method. The catches that are being landed by the fishermen are quite satisfactory but there is no certainty of the catch as the fish moves in small scattered shoals and is available from the 8th phase of the moon to the 2nd phase of the new moon only. Studies will, therefore, have to be conducted to find out its migration during the remaining period.

Since attempts to fish with anchor method failed, the Centre tried to make some improvements in the local gear for increasing their catches. The height of the net was increased from 10 to 20 meshes, but these experiments also proved to be unsuccessful as the increase in the height of the net tends to prevent gear from remaining erect and nearly 6 to 8 meshes are actually dragged along the bottom and the net rolls, on account of strong current.

The nets are prepared out of Italian hemp twine which is costly. The life of the net is about two years. Taking into consideration high cost of investment in this type of fishing the fishermen are gradually giving up fishing by this method. The Centre experimented with the Italian hemp and synthetic twine like nylon and terylene, as it was considered that the synthetic fibre would prove more durable than the hemp twine, thereby saving a little on cost and labour involved in tanning the nets of hemp twine. The experiments proved that the catches were comparatively less in the nets of synthetic twine. Attempts are, therefore, to be made to find out the reason for not getting better catches with the synthetic fibre.

Experiments were also conducted to work out the suitable mesh size for 'Dara' nets. It was observed that 9½ in. and 10 in. mesh is the best size for gilling Dara.

With the last three years' experience it has been observed that the use of plastic floats, cement sinkers, decking the boat and net shooting arrangements on board and gurdy for heaving the nets will increase the landings of Dara considerably.

Trawling

The trawling experiments were conducted for the first time with the help of Satpati type of mechanized craft. It was found that the present H.P. of the engine was not sufficient for trawling as the boat was not able to take the undue tidal current while trawling. Few experiments were also conducted to see the results of trawling across the tide. The catches were somewhat better. The exact H.P. required for conducting trawling with the existing boats will have, therefore, to be worked out. Attempts will also have to be made to decide whether bull-trawling can be done with two boats.

Drift-net fishing

Experiments were conducted to increase the catches of drift nets. The Centre increased the height of the gill net from 15 ft. to 18 ft. and also prepared the nets out of nylon twine. The local gear is made out of Indian hemp or cotton twine. With the use of synthetic fibre and increase in height of the net the catches have actually doubled that of the local nets. The number of nets can also be increased, if provision is made on board for deck, net-shoot and gurdy etc.

Other experiments

Experiments conducted on the preservatives to be used for tanning the nets have proved that "Cuprinol" works better than the local bark but the non-availability and high cost of the former prevents the fishermen from using the same.

Experiments conducted on floating material indicated that the plastic floats are superior to local wooden float for the reasons that the wooden floats can be used for two years and they lose the buoyance with the result that the fishermen have to adjust the weight of the sinkers accordingly. This also involves additional work. It is true that the plastic floats are costlier than the wooden floats. However, it is felt that if these floats are imported on large scale or manufactured in India on commercial basis they will prove economical to the fishermen in the long run. Change in floating material will also necessitate a change in sinkers. The stone sinkers which are being used at present got themselves entangled in the net and thus are disadvantageous to the fishermen as he has to waste lot of time and labour in clearing the gear. It also deprives him of the catch by means of entanglement at the time of actual fishing. All these disadvantages can be eliminated by replacing the stone sinkers with cement sinkers and wooden floats with plastic floats.

RESULT OF MECHANIZATION

Increase in production of fish

An increasing demand for engines from fishermen indicates that there is a definite increase in the production of fish. No fisherman will come forward for engine if he

knows that it is going to cost him more. However, the present stage of mechanization has proved advantageous to the fishermen from places in and around Bombay as they get ready market for their catch and their women-folk can go to the market in time and effect the sale of fish direct to the consumer.

Increase in fishing efforts

Fishing effort has been increased due to the fact that the fishermen are using more number of nets. This can be supported by the fact that a sail-boat can use 70 Dara nets at a time whereas a mechanized craft can operate 100 to 125 nets at a time. Not only this but the mechanized craft can exploit the grounds which are inaccessible to the sail-boats which ultimately result in more catches. With the introduction of mechanization the fishermen from Satpati are going up to Jamagar, 400 miles away for Dara fishing when the local catches are poor.

In case of bag-net fishing the number of nets used by a mechanized and non-mechanized craft is the same but the mechanized craft has advantage to fish for more days and it can make use of both the tides during 24 hours *i.e.* they can fish twice a day. Further some of the crafts are being used for mother-ship operations while taking advantage of both the tides *i.e.* the group owns a mechanized as well as a medium sized sail craft. The sail craft is stationed at the stakes for fishing during every tide with the bag-net and the mother-craft is used for transporting their catches and also to replace the crew and for providing the sail craft with daily requisites.

CERTAIN PROBLEMS CONNECTED WITH IMPROVED METHODS OF FISHING GEAR FROM SMALL POWER BOATS

By

K. CHIDAMBARAM

The development of marine fisheries in India, including deep sea fishing, was given special attention immediately after the last war. Fishing in offshore and distant parts of the high seas for surface, midwater and bottom fishes, was undertaken along two main lines :

(1) to increase the range and duration of the fishing operations by mechanisations of fishing craft; and

(2) to undertake exploratory fishing with the object of introducing new methods.

Mechanisation of fishing craft consists of the installation of engines for propulsion and the use of mechanised devices for handling fishing gear. Increased fish production alone may not justify mechanisation of fishing craft; it must also give a higher economic return to the industry and a greater safety to the fishermen.

The problem of the evolution of a mechanised boat to replace the indigenous non-motorized crafts—canoes, dug-outs, dhonies and vallams—s complex. Another problem with the Fisheries Departments is to determine whether the existing fishing boats, often amounting to thousands, should be mechanized with a somewhat low efficiency or whether they should be replaced in favour of h'ghly efficient boats of altered design. The existence of about 35 widely different types of local boats in different coastal regions of India, suitable for mechanisation, and those of dug-outs and catamarans indicate the magnitude and complex nature of the problem.

The maritime State Governments have launched programmes for mechanisation of indigenous crafts and/or of improved designs of fishing boats. With the valuable experience and gu'dance of FAO Naval Architects and those of Indo-Norwegian Project, especially, Traung, Ziener, Rasumussen, Gurtner and Z mmer during the last five years, new designs of mechanised fishing boats have been developed in the States of Bombay, Mysore, Kerala, Madras, Andhra, Orissa and West Bengal. Some of the designs drawn up earlier have already been improved upon with the exper ence gained with the operation of different types of fishing gear. At present mechanised fishing boats ranging in length from 22 ft. to 40 ft. have been constructed in the various coastal areas. Tr als are being conducted to evolve an efficient and economic design, so that a surf boat would become the proto-type of an extremely useful craft for surf-beaten coasts.

The mechanisation of indigenous fishing crafts has enabled fishermen to fish in offshore waters, which were previously inaccessible to them, to save the time taken in going to and returning from the fishing grounds and to fish for longer hours. Mechanisation is relatively cheap, produces quick results and causes the least amount of dislocation in the existing economy. It is necessary to appreciate that in the long run, the mechanised fishing would come to stay as an economic unit with a few suitable designs of craft, capable of operating fishing gear by mechanical aids for a major part of the year and with adequate provision for storage of fish. It is this factor that is responsible for the modifications of the design of mechanised boats in the different coastal areas within such short periods. With the results achieved so far and the demands for marinc engines, the programme of mechanisation of fishing craft has definitely come to stay. But the mechanised boats, even in Bombay, where there are over 1,000 boats, have not yet been utilised to the full fishing efficiency.

Otter Trawling

Hauling in Cod-end

Fishing Gear

The efficiency of fishing boat is reflected on the effective operation of fishing gear for a larger portion of the year with a minimum operational cost. This leads to the development of suitable types of fishing gear for different fisheries and for the varying conditions obtaining in the different areas. For instance, if a particular area abounds in different kinds of fishes in different seasons, requiring different gear, then the boat must be equipped for fishing with different types of gear and with mechanical aids.

The construction of fishing gear is much dependent on the type of fishing and habits of the fish. The various factors influencing the economy of the gear are the initial cost, useful life, cost of preparation, maintenance and efficiency. The efficiency of the gear will depend on size of the net, its availability for use for a long period, its holding capacity, etc. The main kinds of gear which are commonly used in commercial fisheries can be classified as under :

(1) Trawls;
(2) Round Haul nets;
(3) Gill nets;
(4) Lines;
(5) Traps.

Trawls—Otter trawls vary from country to country and even port to port. The important factors involved in setting the trawling gear are (*i*) speed of tow; (*ii*) length of warp used in relation to depth of water; (*iii*) angle of otter doors; (*iv*) length of the ground cable; (*v*) weight of foot rope; (*vi*) floats on headline; and (*vii*) proportion and mounting of the trawl. The question of distribution of strain on the trawl is of great importance.

The design of trawlers is undergoing an important change; instead of a single deck trawler arranged for handling the gear over the side, the future development points to the use of shelter deck vessels arranged for handling the trawl gear over a ramp at the stern (Birkhoff-1957).

A bottom trawl with hydrofoil otter-boards and a lighter net bag made of perlon, proved that the towing resistance was about 30% lower than the common herring bottom trawl; about 80% of the decrease was due to the boards and 20% to the lighter net (Scharfe, 1957).

Mid-water trawling—Floating or pelagic trawling—is still largely exploratory and experimental. This has been introduced since the Second World War in commercial fisheries of some countries for exploiting concentrations of fish in the water layers, away from the sea-bed. The success of a mid-water trawl in one area for one fish is not a guarantee of its suitability in another area for other species of fish or for other types of craft. The introduction of mid-water trawling for herring in European waters and particularly the success of the two boat trawl developed by Robert Larsen of Denmark aroused interest in Canada. Two boat operations are expensive and efforts were made in Canada to develop a trawl for use in commercial fishing for herring by moderate sized trawlers or multi-purpose boats for providing additional income. Laminated plywood otter boards and synthetic fibre were used. Smaller nets were also rigged for use from small trawlers (45 ft.) with aluminium dual purpose otter board, for obtaining herring at the bottom and mid-water. Experiments are being continued to develop mid-water trawl for catching fast fish—by fast towing of a specially strengthened net and slow towing of a large mouthed net.

The factors governing the design, operations and efficiency of mid-water trawls are :

(*i*) regulation of fishing depths;
(*a*) means of detecting the depth of fish concentration; (echo sounder);

(*b*) means of ensuring that the trawl operates at the required depth (depth measuring device);

(*ii*) importance of biological factors :

(*a*) flight reactions;

(*b*) shoaling habit;

(*c*) visibility;

(*d*) reaction to temperature.

The general features of the design of mid-water trawl and its operations are :

(1) a net with a large vertical as well as horizontal mouth opening;

(2) extension of the lower surface of the net as far as the upper surface;

(3) smooth water flow characteristics;

(4) fast towing speed;

(5) minimum visibility, noise and vibration of gear units.

Since the design of two boat trawl in Scandinavia in 1948 by Larsen, one boat floating trawls were designed in Scandinavia—Phantom trawl; in Iceland Bredford trawl; and in Canada—the British Columbia trawl. In one boat trawl, the two important factors in designing the shape are the total opening and the stability of the trawl during fishing.

The trend of future development of trawling gear from fishing boat (40 ft.—45 ft.) is towards dual purpose bottom and mid-water trawls, which can be worked on or off the sea bed.

Trawl nets tried by Illugason on the south east coast and west coast from 24 ft. "Dan" boat and 36 ft. boat (Samudra) and those by Skapti Jonsen off Saurashtra coast yielded satisfactory results. The different types shrimp trawls designed and tried by Nakai from 36—40 ft. boats procured under T.C.M. are yielding promising returns. A combined fish-shrimp trawl operated from Flying fish and the otter trawling from 'M' boats by the Indo-Norwegian Project gave encouraging results. Otter trawls and mid-water travel tried by Burroughs from the 35 ft.—45 ft. boats off Bombay gave useful information for developing better designs, for economic operation from small power fishing boats. Beam trawls are also being tried by Miyamoto and Burroughs. It is desirable to develop suitable designs of trawls, to work at the bottom and mid-water from power boats (30 ft.—45 ft.) for fishing in the different regions. The problems faced by the different technicians could be usefully discussed.

Gill-nets—Improved types of gill nets with synthetic fibre, effective sinkers and floats were developed for operation from mechanised boats in Bombay, Mysore, Kerala, Madras and Andhra with the assistance of technicians provided under the foreign aid programmes. It is necessary to make this operation efficient by using as many units of gear as possible with mechanical aids and by modifying them for operating in varying conditions.

Purse-seines—Experiments on purse-seines are now being tried on the West coast from medium sized boats by Illugason on the Malabar, South Kanara coast and by the technicians of the Indo-Norwegian Project. The results of the trials undertaken by the Indo-Norwegian Project indicate good possibilities of the operation of the gear from such boats.

Hooks and lines—With reference to hook and line fishing and long lines, preliminary trials indicate encouraging results. The need for increasing the number of units for fishing gear and mechanical handling is obvious. The types of deck equipment will have to be devised for work from small power boats.

Deck equipment—With the designing of gear suitable for fishing in different areas from power boats, it is essential to device simple and suitable deck equipment of

standard patterns of winches, gurdies, line haulers, etc. The need for proper trawling winch for work from small power boats and two drum trawl winch for balloon type trawls and modification of the northern dragger winch has been brought out during the experimental fishing operations in Bombay and Cochin. The suggestion for certain standard types are made with a view to enable fabrication of these items on a large scale.

Net materials—Investigations on the common and characteristic materials for fishing gear, preservation of nets, manufacture of sinkers and floats and production of fishing gear by mechanical means are being undertaken at the Central Fisheries Technological Research Station, Cochin.

In selecting the raw fibre and thread for nets and ropes, it is essential to see that the gear would satisfy the following requirements which influence its efficiency.

(1) the thickness of diameter of the thread;
(2) its weight in air and water;
(3) sinking speed;
(4) strength and elongation up to the breaking point;
(5) strength and elongation at knot;
(6) friction resistance;
(7) resistance to sun light and sea water;
(8) knot features;
(9) resistance to shock, heat, chemicals and fatigue;
(10) elasticity;
(11) susceptibility to dye and dye fastness;
and
(12) plying and fabricating capacity.

In India, cotton and hemp twines have been in use for a very long time. The various characteristics required to make fishing twine with cotton and hemp are to be studied in detail with a view to manufacture them specifically to meet the needs of the fishing industry. Of late, synthetic fibre is fast replacing vegetable fibres but, still, for certain types of gear cotton and hemp will continue to be in use.

Synthetic fibre came to be used in commercial fishing in Japan, Europe, U.S.A. and Canada since 1948. The first use for which nylon proved highly successful was in the manufacture of gill nets. The economic advantages of using synthetic fibre for all types of gill nets have been proved beyond doubt in U.S.A., Canada, U.K., Russia, Japan, East Africa, W. Africa, Finland, Norway, Sweden, Germany, India, Ceylon etc. Experience in Scandinavia and Canada indicates that good results are obtained in mid-water trawling and in U.S.A. and U.K. in seine nets. The important characteristics are (1) low visibility, (2) tensile strength, (3) smooth surface, (4) stretch recovery or elasticity, (5) rot resistance, (6) abrasion resistance and (7) low moisture absorption.

The various kinds of synthetic fibres used in fishing industry are : Nylon, Terylene, Perlon, Amylon, Kuralon, Saran, Tetran and Kapron.

The synthetic fibres do not have in an otter trawl the same advantages over vegetable fibres, as they have in the gill net. Even though they are strong and impervious to sea rot, their high cost is against their general use, as in otter trawling the possibility of loss of all or part of the net is always present. The effect of tropical conditions, high temperature and sun light, on fishing nets of synthetic fibre is also to be studied, with a view to develop a suitable quality.

The various factors influencing the choice of floats will be (1) buoyancy, (2) low rate of absorption of water, (3) the ease with which they could be attached or removed from the net, (4) resistance to different pressures, (5) cost etc. The

economics of indigenous materials for floats and other materials like aluminium, steel, glass and rubber should also be considered.

Besides the various items suggested for consideration, a beginning will also have to be made some time in the use of light and electricity for fishing and in locating fish concentration by thermo-metric method, echo-sounders and radar.

The Central Fisheries Technological Station (Gear Wing), established at Cochin in 1957, is being organised to undertake studies on the materials used for the construction of fishing gear, design, comparative efficiency, preservation, methods of location of fish, reaction of fish to both natural and artificial stimulii and hull designs of fishing boats and ships, engines and machinery for mechanisation, navigational equipment, etc.

The gear section will investigate on the common and characteristic materials used for fishing gear; preservation of nets; manufacture of sinkers and floats; designing and construction of new types of gear; mechanical production of fishing gear; estimation of efficiency of different gear, mechanised operation of gear, use of auxiliary equipment, detection of fish schools, their reaction etc. A beginning has been made in the studies on gear materials and their characteristics, the efficiency of kinds of preservatives, use of small net making machines, use of beam trawl, bamboo lift net, round haul nets, etc.

EXPERIMENTAL FISHING FROM SMALL POWER BOATS IN SOME INSHORE AND ESTUARINE WATERS OF ORISSA

By

P. MOHAPATRA, N. K. MOHANTY, AND R. J. NAIDU

In coastal areas of Orissa, fishing is more or less seasonal, as regular operations are supended before and during monsoons. The fishermen confine their activities to a narrow belt of about seven miles at a depth of less than fifteen fathoms, while the inshore waters far from their villages and the off-shore areas are left practically untapped. Existing inshore fishing boats are represented by catamarans and bar boats, and paucity of harbour facilities has made the former an indispensible fishing craft. The gears operated are simple hand lines, gill nets, beach and boat seines.

Estuarine fishing boats are represented by large bottomed boats and small dugouts, and gears used are fined nets, handy gill nets, drag seines and boat seines. Intensive fishing in estuarines is mostly done during winter and early spring.

Mechanisation of the fishing industry would offer scope for the development of small scale fishing by over-coming many of the present limitations and handicaps. Existing fishing boats were found unsuitable for mechanisation, and it was therefore necessary to try suitable motor boats. For the open beaches, beach landing crafts are necessary, but it is however possible to operate small mechanised boats from some river estuaries both for marine and estuarine fishing. In Orissa, both Candbali on the Dhamra estuary and Paradip on the Mahanadi estuary need development as fishing ports, as this would help to exploit the vast resources nearby. It is from these places that the Department of Fisheries, Orissa has recently started experiments on fishing from small power boats.

Small power boats tried for fishing

Practically all the fishing experiments done so far have been carried with the help of three Dan boats provided under the T.C.A. Programme. They are carvel-built, 22 feet long, 7½ ft. broad and 3¼ ft. deep. The boat has a keel under the central and aft portion of the hull, which curves forwards making the stem rounded. The deck is rounded and pointed both fore and aft, and the carrying capacity is greatest abaft. A semi-diesel engine developing 10 BHP is placed aft, which drives a capstan on the starboard side amidship, but this has not been found to work satisfactorily for slightly larger gears. There is a net roller on the starboard gunwale. The Dan boat lifts well and takes less water over the bow, and it slips readily as the stern lines are slim. The boat has given satisfactory service both in inshore and estuarine waters.

Besides Dan boats, a few trials were made with a 22 feet cutter type motor boat equipped with a 15 BHP engine, but this has not been reliable even for rough estuarine waters. The stem of the boat is straighter and there is a deep keel aft. The bow is pointed, the stern is square and the engine is placed amidships with a steering wheel in front. This boat does not lift well and there is considerable rolling when the load is not sufficient aft.

Gears Experimented and Results Observed

The Dan boats have been used for fishing with different gears in some inshore and estuarine areas, the consolidated results of which are shown in Tables I & II. The fishing trips were purely exploratory and experimental in nature, and the aim was to evolve the best types of gears suitable for local conditions with small power boats and the economy factor was not taken into consideration during these initial

stages. The success of different gears in terms of catch were found to depend largely on the selection of the fishing grounds, availability of various fish spceies, time of operations, tide position etc. In the following paragraphs, the results of the gears tried are briefly discussed.

Observations on fishing gears operated in some inshore waters—Table I indicates the gears experimented during the winter of 1957-58, their specifications and the results in terms of catch. Except a single observation with drift nets near the Polmyras Point, all the other observations were in the areas near Paradip. Fishing is not done by local fishermen in these hitherto untapped areas as they confine their work to the estuary. These areas were also selected because of their proximity to sheltered creeks inside the neighbouring estuaries, which are used for mooring the boats.

Only four types of gears were tried, one of which was indigenous. Simple hand lines baited with fresh fish were found suitable for seer and tunny fishes, as well as for small schools, but these can only be used when small schools are located by the operators. There were no chances of the line breaking, as thick nylon twine were used. Hooks between No. 3 and 8 have been found useful for fishes between 2 and 3 feet in length. The average yield for this gear has been 40 lbs. per working hour.

Nylon drift nets of 5 in. and 7 in. mesh gave good catches in quantity, but about 92.5% of the fish were sharks, which damaged the nets considerably. Other fish caught in minor proportion included black pomfrets, seer and tunny fishes. These results indicate that 5 in. and 7 in. meshed drift nets do not seem to be suitable for inshore waters not far from river mouths, where sharks and other elasmobranch are quite abundant. Such nets are proposed to be tried for exploratory work in inshore and offshore areas further south of Paradip 2 in. meshed bottom gill nets made of yarn yielded 57.4 lbs. per hour, but almost all the catches were small sharks and dogfishes.

The boat seine, which is a common inshore gear in South Orissa, gave good results, though it was mostly operated by catamarans. It was also tried from Dan boats, but no inference on the relative catching power can be drawn at this stage. The average boat seine is about 6 fathoms long from the mid-headrope to the cod end, and the headrope (or ground rope) is nearly 28 fathoms. The mesh decreases from 2½ in. at the mouth to ¼ in. at the cod end, so as to retain small varieties like shrimps. Regular observations are shortly to be made on the efficiency of the existing gear with Dan boats or catamarans. Modified forms of gear with shorter wings and a square piece on the upper half of the net are also being experimented shortly.

Observations on fishing gears operated in some estuarine waters.—Table II indicates the gears experimented in the Dhamra Estuary (excepting shark lines which were tried in the Mahanadi estuary) their specifications in brief and the results in terms of catch. There tidal estuaries are not fished throughout the year, as intensive fishing is only seasonal. The gears of the local fishermen are not very effective, and most of the gears tried with the power boats are somewhat new to the area. The experiments were done all the year round and in some areas where the local fishermen have no access.

Long lines with an average number of 100 hooks (Nos. 10 and 14) with nylon snoods and main line have not given good results with fresh fish baits. Most of the catches were small catfishes between 6 in. and 8 in. in length. It was, however, noticed that pelagic nets gave comparatively better catches than bottom sets, and further trials on this gear with other baits are being done.

Shark long lines set in the Mahanadi estuary with 30 hooks gave fairly satisfactory yields, and is being proposed to give more emphasis on this gear for sharks. A 3 in. meshed nylon net 50 fathoms long was tried to barricade a portion of the estuary which fills up during high tide and dries up during low tide. Usually local

yarn nets are used for such purposes by the fishermen, and the results showed that nylon nets were superior to ordinary yarn nets due to their durability. Of course this method of fishing required little skill and in the true sense has nothing to do with power fishing, but since nylon nets were tried this has just been noted for reference.

Nylon drift nets of different mesh sizes (3 in., 5 in. and 7 in.) were also operated, but the yields were not satisfactory, the average catch being only 6 lbs. per hour. Catfishes and cock-ups were the main catches the size of the fish depending on the mesh size. Usually the sets tried were 100 fathoms long and 3 fathoms deep. The gear is difficult to operate in narrower areas due to strong tidal currents, the speed of which varies in different sections of the estuary simultaneously. Only small drift nets are used by the local fishermen for small clupeids.

As operation of drift nets with one boat is difficult since the net cannot be stretched uniformly, it was necessary to try gill netting with nets that could be stretched with the help of two power boats at both ends and moved with the current. The net tried was made of nylon and measured 100 fathoms and 6 fathoms, the mesh size being 3 in. The yield which came to 26.4 lbs. per hour indicates that this is an effective method of gill netting for the estuarine but the disadvantage is that it cannot be operated against current due to the low horse power of small boats. The method required further study and the mesh size has to be altered according to seasonal abundance of different varieties and sizes of fish.

Both bottom and pelagic set gill nets were tried, but the setting was difficult due to the strong tidal currents. Bottom sets could not be properly set at right angles due to the alternating tides which makes the headrope slaut towards the direction of the current. On more than two occasions, portions of the nets were washed away and connecting anchors lost. Pelagic gill nets were also difficult to set for the same reason as the ground rope tends to slaut towards the current. The average yields with both 2 in. and 3 in. meshed nets were very low being about 3.3 lbs. per hour. Local fishermen often use small large meshed bottom nets anchored by means of several stout poles, but these are washed away at times.

Another fishing method tried in the estuaries was to encircle an area by means of a straight net and it warps and thus hauling it ashore, somewhat like a shore seine. The yield was fair in comparison to other gears, and it is proposed to make a number of observations with nets of different mesh sizes. The gear cannot be conveniently operated along deep banks.

Boat seines used for inshore fishing had also been tried in the estuaries, but the average yield was very low. The gear is very large and heavy and cannot be used conveniently due to the unknown bottom, which is a major disadvantage in estuaries.

A smaller two boat nylon trawl with slightly larger meshes gave better results than the boat seine. The headrope is 15 fathoms, the footrope 18 fathoms, and the mesh size decreases from 3 in. at the mouth to ½ in. at the cod end. The disadvantage is that it can only be towed in the direction of the current due to the low horse power of small boats, and can be operated in areas where the bottom is fairly even.

Concluding Remarks

From these fishing experiments, it will be noticed that certain gears have given quite conclusive results as regards their suitability or unsuitability under certain conditions, though the observations taken may be few. Such results in the initial stage are helpful in planning out the future power fishing experiments, and during the next three years, it is being proposed to try different types of fishing from small mechanised boats in the inshore and near offshore waters. Besides hand lines which are to be tried extensively in various parts of the coast, both bottom and pelagic long lines are to be tried for different fishes. Trolling experiments for Mackerel and allied species

also seem to be necessary if shoals are located. Nylon and yarn drift nets for sardines are being tried from the coming season and larger meshed drift nets will be used as mentioned earlier. Besides small meshed bottom gill nets, large meshed nets of nylon and yarn are to be tried extensively for exploratory work. Among interesting structures, nylon shrimp otter trawls, small pair and other trawls, and improved boat seines are being tried soon. In order to exploit areas when the catamarans cannot go of their own mother boat operations from small mechanised boats are to be started from the next season.

For estuarine conditions more emphasis will be laid on such gears as shark long lines, two-boats moving gill nets, small drift nets, small pair trawls and improvised boat seines.

Table I

OBSERVATIONS ON FISHING GEARS

TABLE I

Observations on Fishing Gears Operated in Some Inshore Waters of Orissa

Serial No. of Gear	Gear used	Specification of gears	No. of boats used	No. of operators	Areas of operation	Months of operation	Total No. of observation	Average duration of each observation	Average catch for each observation	Average catch per hr.	Main varieties of fish	Average size
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	[illegible] lines	6 hooks between Nos. 3 and 8 attached to nylon (Nos. 48 and 21).	1	3	Inshore areas near Paradip (South of false-point).	January, 1958	3	6 hrs.	240 lbs.	40 lbs.	Small sharks, seer. fishes.	2′—3″
2.	Drift nets (nylon)	String of 8 nets of 5″ mesh and 8 nets of 7″ mesh the total dimension of the whole string being 400 fathoms x 3 fathoms.	1		Mostly in the inshore areas off Paradip one observation in the inshore waters near Palmyras point.	December 1957 to March 1958	21	10.3 hrs.	835.3 lbs.	81.1 "	Sharks (92.5%) Tunny and Seer fishes Black Pomfrets.	2′—3″ 2½′ 8″—10″
3	Bottom Gill nets (Yarn)	1 net 120 fathoms x 3 fathoms. Mesh being 2″.	1	3	Insore waters near Paradip.	February, 1958.	2	1.25 hrs.	71.75 lbs.	57.4 lbs.	Sharks	10″—1′2″
	[illegible]heme (Yarn)	Headrope and footrope 28 fathoms long. Length of net from middle of headrope to tip of cod end 6 fathoms mesh size from 2 1/2″ at mouth to 1/4″ at cod end.	2	4	Do.	December, 1957 to February 1958.	45	4.4 hrs.	181.3 lbs.	41.2 lbs.	Shrimps and Prawns Bombay duck Jew fishes.	3″ 6″ 6″

TABLE II

Observation on Fishing Gears Operated in Some Estuarine Waters of Orissa

Serial No. of Gear	Gear used	Specification of gears	No. of boats used	No. of operators	Areas of operation	Months of opearation	Total No. of observation	Average duration of each observation	Average catch for each observation	Average catch per hr.	Main varieties of fish	Average size
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	Long lines for cat fishes etc.	100 hooks (Nos. 10 and 14) snoods 2 feet of No. 21 nylon attached to main line of No. 48 nylon, each snood being 5' apart.	1	2	Dhamra Estuary	November, 1956 to July 1958	10	5.3 hrs.	4.21 lbs.	0.81 lbs.	Cat fishes	6″—8″

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
2.	Shark longlines ..	30 shark hooks in a set hooks with swivals and attached to iron chairs and wires which ultimately join the main line of thick coir rope.	1	2	Mahandi Estuary	October, 1957 to December, 1957	7	12 hrs.	120 lbs.	10 lbs.	Sharks	4′—6″
3.	Tidal barricade (with nylon nets).	3″ mesh not set as a barricade during high tide. Length of net 50 fms.	1	3	Dhamra Estuary	July, 1957	1	12 hrs.	200 lbs.	16.7 lbs.	Cat fishes	10″—12″
4.	Drift net nylon ..	String of nets of 3″ mesh dimension of each string during operation is 100 fathoms x 3 fms.	1	2	Do.	October, 1957 to May, '58	24	4.5 hrs.	27 lbs.	6 lbs.	Do. Cock-up	1′8″ with 7″ mesh 1′ 4″ with 5″ mesh 11″ with 3″ mesh 2′6″ with 7″ mesh 1′8″ with 5″ mesh 1′2″ with 3″ mesh
5.	Two boat moving gill-net (nylon).	String of 16 nets of 3″ mesh total dimension 100 fms. x 6 fms.	2	4	Do.	January, 1957 to August 1958	71	2.8 hrs.	73.9 lbs.	26.4 lbs.	Cat fishes cock-ups thread fins sciaenids.	10″—1′ 10″—1′. 1′2″—1′—3″ 1′2″—1′—6″
6.	Set gill nets nylon or yarn.	String of yarn nets of 2″ mesh or string of nylon nets of 3″ mesh length of each string during operation being 100 fathoms.	1	2	Dhamra Estuary	December, 1956 to May, 1958	12	5.7 hrs.	18.8 lbs.	2.3 lbs.	Cat fishes	10″—1′
7.	Shore seine nylon	String of 16 nets of 3″ mesh dimensions 100 fathoms.	1	4	Do.	June, 1957	3	3.6 hrs.	47.9 lbs.	13.3 lbs.	Do.	8″—1′ with 2″ mesh 10″—1′ with 3′ mesh.
8.	Boat seines yarn	Head rope and foot rope 28 fathoms long length of net from midhead rope to cod. end 6 fathoms mesh size from 2 1/2″ at mouth to 1″ at cod end.	2	4	Dhamra Estuary	November, 1956 to March, 1958	4	31 hrs.	5.1 lbs.	1.6 lbs.	Shrimps and Prawns.	2″—3″
9.	Two boat trawl nylon.	Head rope 16 fms. and foot ropes 18 fms. Mesh 3″ at mouth to 1/2″ at cod end.	2	4	Do.	November 1956 to September, 1957	32	3.6 hrs.	50 lbs.	13.9 lbs.	Cock-ups Cat fishes Shrimps Shrimps and Prawns	1′ 2″ 8″—1′4″ 3″

BOTTOM SET GILL NETS

By

S. THYAGARAJAN

Introduction

The Gulf of Mannar is rich in its fisheries and it provides year round employment to the fishermen. The Indian coast on the east of the Gulf has many important fishing centres. Except in two or three places, the coast is generally surf beaten. The presence of rather continuous ridges of rocks and coral reefs close to and parallel to the shore line increases the intensity of the surf and therefore the waves are high and incessant. Small bays and shallow spreads at Tuticorin (8° 48′ N. 78° 10′ E) and Kilakarai (9° 14′ N. 78° 47′ E) areas are devoid of breakers. Fishing is generally done beyond the submerged reefs up to a depth of 15 fathoms. The major fishing grounds are constituted of rocky patches, muddy gullies and sandy stretches.

Fishing Grounds

(a) *Rocky Areas*—Submerged rocky patches at the sea bed are called "Pars". These exist as scattered, but extensive patches. Most of the "Pars" form the pearl banks and Coral beds. Perches of many kinds are found in large numbers in-habitating the rocks. These Pars are fished extensively with Hand-lines and Bottom-set lines.

(b) *Muddy Gullies*—At the estuaries of Thambaraparani and Vaipar rivers muddy gullies extend from shore seaward. These muddy gullies are called "Madais" in local Vernacular. Punnaikayal Madai (15 miles South of Tuticorin), at the estuary of Thambaraparani river extends to 21 fathoms depth and the Vaipar river "madai" (30 miles North of Tuticorin) to 12 fathoms. Both these gullies are very limited in spread, but they are very rich in fish and prawns. Off-shore mud and clay banks also occur eastward of Manapad and Cape Comorin. These form the main grounds of fishing with boat seines, drift nets and bottom nets.

(c) *Sandy Beds*—In the Gulf of Mannar they are called locally as "Changu Nilam" meaning chank grounds. Lakhs of chanks are being fished annually in the North of the Gulf. Depending on the seasonal currents and movements of shoaling varieties like Clupeids, Tuna and Carangids etc., these areas are resorted to occasionally by fishermen for drift netting and trolling lines.

Fishing Crafts

Two main types of fishing crafts are seen in the Gulf in and around Tuticorin and Kilakarai where waves are absent and natural harbour facilities are available; small sailing boats and canoes are the main crafts employed for fishing. In other areas catamarans are in use. The catamaran logs in the Gulf area are large and generally over 20 ft. in length. The logs, tapered slightly at the ends, each about 18 in. in diameter in the middle are lashed together in crescentic manner comparable to shallow keeled boats. Vertical planks are fastened at the end for easy manoeuvre with tillers. These are called boat catamarans. In the surf area where beaching of the craft is a daily affair, these catamarans, are considered as very suitable at present. The sailing boats or canoes in Tuticorin and Kilakarai are carvel built. The Tuticorin boats are usually 32 ft. in length 6 ft. at the beam and 3½ deep. Venteak planks of ½ in. thick are used for planking. The ribs are of Portia wood (*Thespesia Populinia*). These pieces are joined to form one rib. The single masted Tuticorin boat though fragile is strong and its hull is shaped neatly for good speed. There are about 200 boats at Tuticorin and neighbouring fishing villages. The Kilakarai boats are more deep and their hulls resemble dugout canoes with high plankings on either side. The stern and keel are

made of very heavy and thick wood. These are much heavier and stronger when compared with Tuticorin boats. Being light and of simple construction the boats at Tuticorin are easily beached at frequent intervals when the hulls are cleaned thoroughly and coating of tar or oil is applied, if necessary. These help to keep off the borers and also ensure the life of a boat.

Fishing Methods and Gear

(a) *Line Fishing*—Fishing is the main industry in the coastal villages around the Gulf of Mannar. Varied types of hook and line fishing and net fishing are done. The Northern region of the Gulf is suited for Gill netting. From Manapad (80° 23′ North 77° 47′ East) down south boat seines are predominantly in use. The presence of extensive rocky areas of Tuticorin provide ample scope for hand line and bottom line fishing. Perches are abundant in the area and the long line fishermen make a good job of it. In deeper waters up to 50 fathoms "Revolving Chain" hooks are operated for big sharks. Depending on the wind and current, whiffing is done in the months of June, July and August. The landing of fish during these months are mainly from whiffing lines or trolling lines Schools of large sized Caranx, Seer, and Iuna are seen at the surface in the morning hours. During this period these fish have an instinct to strike on bait madly. Full advantage is taken of this and troll lines are very profitably employed.

(b) *Net fishing*—The nets used by the fishermen fall into two main groups Gill nets and Seine nets. Gill nets are operated in large numbers in the Gulf north of Manapad point and in the south Seine nets are more common. The Gill nets are used mainly for drifting. Shoals of Sardines, Ribbon fish, Sabre fish and Anchovies are seen frequently in the Gulf. The meshes of the drift nets have been designed to gill these. There are two main kinds of Surface drift nets (*viz.*) "Kola Valai" and "Vala Valai". The stretched mesh in "Kola Valai" is 28 m.m. One complete set of Kola Valai under operation consists of 8 to 10 pieces, each piece is 15 fathoms in length and 375 to 400 meshes in depth. Light coir of 10 m.m. diameter is used for head and foot ropes. The small meshed webbing is prepared out of 20 count cotton yarn. A double row of selvage is provided at the top and bottom and the net is stapled to the head and foot ropes by stronger twine. The percentage of hanging is 50, but the meshes and selvage run loose on the ropes. The attachment to the ropes is done by a separate line at intervals about two metres. Since "Kola Valai" is mainly a surface drift net, wooden floats, cut out of old catamaran logs are used at every 2nd metre on the head rope to keep the net to the surface and rough coral stones of about 1 lb. weight are used at intervals of 4½ metres to keep the net well stretched rice gruel is used for starching the net. This net is operated throughout the year up to depths ranging from 7 to 10 fathoms and the main catches are Sardines, White-baits and small Herrings. "Vala Valai" is the local Vernacular name for Sabre fish (*Chirocentrus dorab*). The stretched mesh in "Vala Valai" varies between 44 to 52 m.m. It has a depth of about 200 meshes and a length of 20 fathoms. Eight to ten pieces of nets are operated at a time. The net is prepared out of 12 counts cotton yarn and is used in depths ranging from 8 to 15 fathoms. Starch is used on "Vala Valai" also; rarely tanning is done with a boiled solution of tamarind husk and castor seeds. The main catches in Vala Valai are Sabre fish, Ribbon fish, Seer, Caranx, Big-jawed jumper, Baracuda and small Sharks. Both the drift nets, Kola Valai and Vala Valai, are operated from a boat or catamaran and fishing is done all hours, except during the afternoon according to the occurrence and magnitude of shoals. Fishing at nights and in early hours of the morning are more common.

The third type of gill net used by the fishermen in the northern region of the Gulf is called "Pachu Valai". This net is designed for bottom fishing. Well twisted hemp twine or thick dunlop twine with breaking strength of about 60 lbs. are reported to be used for braiding Pachu Valai. The stretched mesh is 119 m.m. and in rare cases 153 m.m. One set of net under operation comprises of 10 to 12 pieces. Each

piece of net measures 80 meshes deep and 15 fathoms long. Strong Coir of 14 m.m. diameter are used for the head and foot ropes. The top and bottom row of meshes are tied to the ropes by a separate twine passing through all meshes, but attached to the ropes at intervals of one fathom. The webbing is hung on the ropes at 50% reduction, but 20 meshes move free on the accessory line between 10 mesh space. The main catches in Patchu Valai are Sharks, Rays, Cat-fishes, Jew-fishes etc. The gill net, unlike the Kola Valai and Vala Valai is intended for bottom fishing. The hours of fishing is mostly between dusk to dawn. The nets are used up to a maximum depth of 15 fathoms. A crew of 5 men operate this net from a boat or catamaran. Equipped with strong side lines, which connect the head and foot ropes at one end to a common iron anchor weighing about 25 lbs., the Patchu Valai is set at one end in the bottom. After laying the net across the tide or current, a heavy stone is let down at the other end. The foot rope is kept down by irregular stones or coral weights of 2 to 3 lbs. at intervals ranging from 2½ to 3 fathoms. The floats used on the head rope at intervals of one fathom are wooden chips of 3 in. diameter and 1 foot long, cut down from old catamaran logs. The operation of this gill net is done mostly in seasons of moderate winds and rather calm seas. Strong fierce winds and faster currents render it difficult for the fishermen to manoeuvre the boat skillfully across the current and lay the net.

From Manapad down south in the Gulf of Mannar, "Boat Seine" nets are used in very large numbers. This net is called "Madi Valai". It consists of a large small-meshed cotton bag with wings and belly formed of coir. The meshes on the bag range from 12 m.m. to 6 m.m. (stretched mesh) fabricated out of 10 and 20 counts cotton yarn. The coir belly and wings have very large meshes of 305 m.m. to 750 m.m. The cotton bag has a circumference of 20 fathoms and 8 to 10 fathoms deep to cod end. The wings extend to 12 fathoms over a belly or platform of 3½ fathoms. Floats and stone weights are used in adequate quantities on the head and foot ropes to keep the mouth of the net well opened during operation. The Boat seine or Madi Valai is operated from two boats or catamarans. Ribbon fishes, White baits, Silver bellies, Jew fishes, Big jawed jumpers and Prawns are the common catches in the Madi Valai. In short the "Madi Valai" used in the Gulf of Mannar is a primitive Bull Trawl whose success entirely depends on the prevailing winds and currents.

The area of the Gulf of Mannar under exploitation is limited. With the craft and gear available the fishermen are able to fish only a narrow coastal belt. It will be profitable to increase and intensify the operations and extend them to off shore and deep waters. Employment of small power boats and improved types of gear will lay a solid foundation towards the advancement of the marine fisheries and gradually shape it on commercial lines. Adoption of new equipment and gear cannot be done without proper trained men. Technical assistance and training facilities must be made available in the initial stage to the fishermen. A centre at Tuticorin has been established to train the fishermen in the modern methods of fishing and managements of power boats. Since its inception in 1956 the training centre has been imparting lessons on the modern trends in inshore and offshore fishing. In addition to educating the fishermen with the knowledge and utility of mechanized boats in fishing in the offshore areas, it was also demonstrated to them how improved tackle and methods of operation can better their catches within the scope of their reach of fishing grounds. During demonstrations, it has come to light that bottom fishing in and around Tuticorin (as elsewhere) in the Gulf, is not conducted effectively by indigenous gear. Bottom line fishing and Pachu Valai are the two gears handled by the fishermen at Tuticorin. A series of demonstrations conducted with the bottom gill nets by the training Institution revealed the greater efficiency of set nets against the Pachu Valai. A detailed description of the bottom set nets and comparative statements of catches are given below for illustration.

Bottom set Gill nets—The Gill nets used at the training centre are braided out of synthetic materials, such as Nylon, Kenlon and Terylone and are operated from

small 32 footer motor boats. For purposes of comparative study, Bottom set gill nets of Nylon No. 7 (breaking strength 57 lbs.) are taken into consideration. The size of mesh is 119 m.m. (stretched) and each piece of webbing is 54 meshes deep and 25 fathoms long. Eight pieces are used at a time for operation. Being fabricated out of synthetic material special types of double knots have been used to avoid knot slipage. Coir ropes, 13 m.m. diameter, are used for head and foot ropes after removal of kinks. The webbing is hung on the ropes at 50% reduction. The top row of meshes is slipped through a hollow pipe; a loose clove itch on every 3rd mesh. The rope is passed through the pipe and the webbing is allowed to slide over the rope from the pipe. Three meshes are hung at $1\frac{1}{2}$ mesh space and the itches pulled tight on the head rope. The bottom row of meshes are also fixed similarly on the foot-rope. This system eliminates the additional twine that is commonly used in laceing the webbing to the ropes. The rope being coir, is coarse and the clove itches do not ride out of position. During operation the eight pieces of net are tied to each other with "Gill netters knot" at the ends of the head and foot ropes. This knot remains loose to enable quick untying, but is strong and will not unfurl of its own accord. Glass buoys of 5 inch diameter with approximate buoyancy of 4 lbs. are used at intervals $2\frac{1}{2}$ to 3 fathoms on the head rope. Similarly stone weights of 4 lbs. prepared out of cement and sand are used at every 3rd fathom on the foot rope. The matter of distributing the weights on the foot rope and the buoyancy on the head rope is mainly dependent on the prevailing current at the bottom during operation of the net. However, it is necessary to maintain a certain amount of stretch and tension on the webbing, so that giling of fish is done quickly and effectively.

The net is set at the bottom across the tide on current direction. Two heavy anchors are used at the ends to keep net laid properly at the sea bed. Buoy lines are tied to the anchors for marking the position. Strong ropes free from kinks are used as side warps to the bottom set nets. The length of these side lines on warps is usually over 3 times the height of the net. This helps to prevent the anchor drag on the nets. The object is to keep the Bottom Set net away from all influences of except the tide or current and at the same time giving a free play for the net that is kept on tension by sinkers and floats.

Taking note of the direction and rate of flow of water a course across the current is charted after allowing for ice away. It becomes possible to control these factors, while using a power boat. Maintaining a good working speed, adjusted to the tide and wind, the boat is run across the current and the net is shot quickly from the boat. Provision of the Net shute in the boat is an added advantage. The marken or Spar buoy line goes down first with the heavy anchor. As soon as the anchor settles down on the bottom, a slight pull is exerted on the side ropes and the flowing net to engine that no entanglement has occurred. Best results are obtained only when the net has been set in a straight line across the current. The anchor of the other end of the net helps to lay the gear properly without any rolling up. It has been found that common iron anchor with arms have a tendency to get entangled in the meshes of the net then closing up a portion of the gear. This trouble does not arise, when flat anchor prepared out of cement are used. Special type of these anchors with iron reinforcements costs less and weighs more. Such a concrete anchor which weighs about 65 lbs. is much cheaper than an iron anchor of that weight and also does not get entangled with the net proper. Good results have been obtained during night fishing. Hence the Bottom Set Gill Nets are mostly operated at dusk and handled next morning. A quantity of 82,770 lbs. of fish were landed during 409 operation of Bottom Set Gill nets by the Fisheries Training Centre. The catches comprised of cat fishes, Rays, Saw fishes, Sharks, Pomfret, Seer, Sabre fish etc. The results of bottom fishing with Set Gill Nets are compared with that of "indigenous" Pachu Valai, which is also a bottom net. A comparative study of the average catch from these nets covering a same period are given below and the efficiency of the Set nets over Pachu Valai for bottom fishing is discussed.

Discussions

Pachu Valai and the bottom Set Nets are both "Gill Nets" and intended for "bottom fishing". The meshes and size of nets are also similar. The material used in Pachu Valai under study is hemp and the bottom set is Nylon. Thickness and degree of twist in both these materials vary, but the breaking strength compares favourably. The season for fishing and the number of operations with Pachu Valai is very limited and the reasons are explained. below. Differences are noted in the mode of operation and assembly of the gear in both cases. As examination of the catches from these nets reveals certain differences which throw light on the efficiency of the nets. Consideration of all the above factors are necessary to adopt an effective gear for bottom fishing.

Different types of materials

Synthetic fibres have many advantages over plant material. For the same breaking strength, the thickness of the twine varies. Hemp twine is much thicker and appears almost twice as thick as Nylon. The thickness of the twine may have a telling effect when small meshes are braided. The net becomes heavy and very conspicuous under water. Flexibility and elasticity are greater in Nylon than hemp. There is also toughness in Nylon twine or any other synthetic product, a combination of strength and elasticity. This probably accounts for larger catches by gilling. Seer, Jew fish, Pellona, Sabre fish, etc., which are usually gilled are more common in the Nylon Bottom Set Nets than in Pachu Valai. Entangling fishes like Rays, Saw fish, Cat fish have been caught in both the nets. It is a point worth noting that the Rays which are caught are all large sized ones weighing 100 lbs. and above. The point in favour of larger catches by Nylon Gill Nets is the toughness in the twine. In Gilling, the twine must be strong and elastic enough to receive the shock from the powerful strike of the fish to hold it. This toughness is different from the breaking strength of the material. Therefore, capture of fish by effectively gilling and also by entangling is observed in the Nylon Net. A greater degree of twist may increase the elasticity in hemp but the twine will snap at the first strike of the fish.

It is observed that though Pachu Valai has been operated during all months, yet the number of operations are limited in the first half year. (Only few Canoes go for fishing with Pachu Valai). Strong westerly winds during May and June and lucrative fishing by surface drift nets and hook line in January to April, are the main reasons. The Pachu Valai is operated from the sailing boat, which is difficult to manoeuvre across adverse winds and fast current, while operating a bottom gill net.

The essential difference in the mode of operation of the two bottom nets account for the low average catch in Pachu Valai. Being shot from a power boat, the bottom set Gill Net is fixed across the tide with the aid of heavy anchors at either ends. The net starts fishing as soon as laid till it is hauled up. In case of Pachu Valai, only one iron anchor is tied to one end and a heavy stone capable of just drifting with the tide is fixed. However, skillfully steered, it becomes difficult to shoot the Pachu Valai from the sail boats across the current. The drifting of the boat with the flow of water and at the same time shooting the net in taught condition is not possible. Therefore, the fishermen seek the aid of the return tide to bring the net to proper position. With one end anchored, the long piece of net is carried to different positions in the manner of an arc. Considering this, it is doubtful to classify Pachu Valai either with drift nets or Set Nets. Nets when drifting hang in the sea and move along with the tide or current. Movement is seen with relation to the sea bottom. In Set Net there is no movement in relation to the sea bed, and the gear is stationary. The Bottom Set Gill Nets of Nylon used by the Fisheries Training Centre are of sationary type. But Pachu Valai, which is also designed for bottom fishing is a combination of drift and set. This however restricts the actual hours of fishing by the net. There is too much movement, as part of the net drifting with the tide and, in relation to the ground.

Unlike the Bottom Set net which starts fishing right from the hour of operation, Pachu Valai fishes effectively only when the flow of the tide is less. Too much flow of water through the meshes, when the net is not across the tide, closes up the meshes and render giling ineffective. Thus it is observed that though the duration of operation of Pachu Valai and Bottom Set net are same, the actual hours of fishing by Pachu Valai is less and this results in low catches.

TABLE I

Kind of Fish	Bottom Set Net		Pachu Valai	
	Quantity of fish in lbs.	Percentage	Quantity of fish in lbs.	Percentage
1. Cat fish	20,236	42·15	5,092	22·19
2. Rays	7,434	15·48	7,626	33·23
3. Saw fish	7,433	15·48	6,115	26·64
4. Sharks	5,100	10·5		
5. Pomfret	1,836	3·6	814	3·54
6. Seer	1,838	3·3	—	—
7. Sabre fish	1,020	2·1	—	—
8. Thread fins	511	1·6	1,372	5·98
9. Pellona	510	1·5	—	—
10. Jew fish	409	0·9	1,302	5·69
11. Soles	306	0·6	—	—
12. Miscellaneous	1,465	3·0	628	2·73
	47,998		22,949	

TABLE II

Month	Bottom Set Net		Pachu Valai	
	No. of operation	(Weight in lbs.) Average catch per operation	No. of operation	(Weight in lbs. Average catch per operation
January	43	207	6	39
February	27	135	9	65
March	35	167	8	60
April	24	201	5	25
May	24	99	—	—
June	8	100	2	72
July	32	187	23	84
August	23	105	12	120
September	9	83	23	85
October	7	76	25	177
November	11	72	25	150
December	36	280	23	100

ON THE RESULTS OF FISHING WITH SMALL MOTORIZED BOATS IN MADRAS STATE

By

G. K. KURIYAN AND B. KRISHNAMURTHY

In a seperate paper (1) the authors have presented the technical details of the general scheme of mechanisation of fishing crafts in Madras State. In the present communication are embodied an evaluation of the success of this Scheme of fishing with small motorized crafts, particularly the so-called "Pablo" type boats.

Description of Craft and Gear

The boats are of the following specifications :

Length O.A.	24′—7″
Beam	6′—10″
Depth	3′—6″
Draft (maxi)	2′—9″
Displ.	2·6 tons
Engine	10 H.P. High Speed marine diesel with 2:1 reduction gear and water cooled.

The boats are of wood and are of the open type with cruiser stern. Apart from a net chute, the boats are not provided with any mechanical devices for fishing.

The boats are equipped with synthetic yarn bottom set gill nets of the specifications indicated below :

Webbings of 50 fathoms length (25 fms. as net), 3½ fathoms depth and of mesh size 3″ and 6″.

Each 24′ boat is provided with 10 nets of the above specifications.

The boats are operated by the Fishermen Co-operatives to whom the boats and nets are sold by the Government under subsidy and on a system of hire-purchase. The crew for the boats are mainly drawn from among the trained personnel of the State Government Training Centres for fishermen.

Materials and Method

The present communication is based on the data collected about the fishing operations with the boats stationed at Madras, Porto Novo, Killai, Tuticorin and Colachel for a period of one year. The efficiency of these motorized crafts as compared with the catch data of catamarans and canoes for approximately the same sampling period has also been worked out.

Only the actual number of days of fishing have been reckoned to work out the catch-per-fishing day. A uniform rate of 0.50 nP. per lb. of fish has been adopted for comparison of sale proceeds.

RESULTS

Pablo boats

Each "Pablo" boat employs a crew of four fishermen in addition to a driver. The wages of the driver are met from the days earnings at 18% of the catches. The catch-per-effort (*i.e.*, catch-per-man-per-fishing day) after deducting the share of the driver is given in Table I below :

TABLE I

Month	Place					
	Porto Novo	Cuddalore	Killai	Madras	Tuticorin	Collachel
February	—	—	—	48·5	11·0	—
March	—	—	—	—	28·2	—
April	—	—	—	26·2	37·4	—
May	8·1	31·3	23·6	56·9	31·3	2·0
June	6·9	12·6	15·0	26·4	5·6	100·0
July	—	34·0	19·7	222·0	48·2	20·9
August	10·4	15·1	15·6	53·0	39·0	120·0
September	2·1	19·6	5·6	59·6	70·0	19·0

The catch-per-effort in lbs. per fishing day for the "Pablo" boats

On the basis of the above catch data, the average value realised for the fish for the sampling period is given in Table II below :

TABLE II

Centre	Value in Rupees
1. Madras	35·2
2. Cuddalore	11·3
3. Killai	7·9
4. Tuticorin	33·8
5. Colachel	45·0

Country Crafts

The average catch-per-man-per-fishing day for the sailing craft and catamaran is presented in Table III below :

TABLE III

Month	District or Place	Catamaran	Sailing Craft
January	Tanjore	—	36
	Pamban	—	—
February	Tanjore	—	15
	Pamban	—	25
March	—	—	—
April	Tanjore	—	9
	Pamban	—	23
May	Tanjore	—	8
	Pamban	—	14

TABLE III—*contd.*

Month	District or Place	Catamaran	Sailing Craft
June	Tanjore	—	6
	Pamban	—	25
	Madras	28	—
July	Tanjore	—	8
	Pamban	—	19
	Madras	22	—
August	Tanjore	—	6
	Pamban	—	23
	Madras	21	—
September	Madras	22	—
October	—	—	—
November	Tanjore	—	11
	Pamban	—	20
December	Tanjore	—	4
	Pamban	—	35

Average catch-per-effort in lbs. per fishing day of the catamaran and the sailing Craft

The sailing boats employ 5 to 7 men per boat and operate boat seines, cotton gill nets and occasionally trolling lines. A catamaran is operated by 4 fishermen for gill nets, seines and lines.

The average catch per fishing day for the country crafts and the value realised are as follows :

	Weight in lbs.	*Value in Rs.*
Catamaran		
Madras	23	11·50
Average	23	11·50
Sailing Craft		
Tanjore	11	5·50
Pamban	23	11·50
Average	17	8·50

Economic aspects

That the motorized boats with modern gear get a better catch-per-effort over the local type of craft and gear is obvious from the data presented. However, since both craft and tackle involve a larger initial outlay, the results have to be assessed from the economic angle.

Although the expenditure on the maintenance and running charges for the motorized boat vary in the different centres, the approximate average expenditure on maintenance etc. of a boat and gear per day is as indicated below :

	Rs.
Fuel Oil, lubricant etc.	4·75
Payment towards capital cost of the boat	4·25
Payment towards capital cost of gear	5·00
Approximate depreciation	0·25
TOTAL ..	14·25

Depreciation varies from 20 to 25 nP. per day at the rate of 10% per annum. It has been taken at a flat rate of Re. 0.25 per day. The interest on Capital cost has not been taken into consideration as this is borne on Government account.

Very little amount is spent for maintenance of a catamaran and that for a sailing boat may not be more than Rs. 10 per month. The depreciation for these crafts have been worked at 10% of the capital cost which is about Rs. 650 for a catamaran and Rs. 1,000 for a sailing boat.

The comparative receipt and expenditure statement for these three classes of craft is given in Table IV below :

TABLE IV

	Catamaran		Sailing boat		Pablo boat	
	Exp. in Rs.	Recpt. in Rs.	Exp. in Rs.	Recpt. in Rs.	Exp. in Rs.	Recpt. in Rs.
1. Maintenance	Nil	—	0·04	—	14·25	—
2. Depreciation	0·20	—	0·30	—	—	—
3. Interest on Capital	0·08	—	0·13	—	Nil	—
4. Receipt	—	11·50	—	8·50	—	26·64
5. Net Profit	—	11·22	—	8·03	—	12·39

Discussion

The increased catch with motorized boats using modern gear is apparent from the analysis given earlier. The Scheme has vastly contributed to the initiation of the modernization of the industry and also provide better working conditions for the fishermen. In view of the System of hire purchase, initial capital investment of a large amount on the part of the fishermen is not necessary. The depreciation for the motorized boats to be actually borne by the fishermen will also be less than what is indicated in the paper as these have been worked out on the basis of actual cost whereas the fishermen repay only cost less the subsidy from Government. The ownership of the boat is also transferred to the fishermen after repayment of the cost due.

It might appear from the tables that the earnings per fishing day for the catamaran is almost equal to that of a motorized boat. The number of days of fishing possible with a motorized boat is much more than that of a catamaran. The annual earnings of a motorized boat would consequently be increased considerably. It also deserves mention that fishing would be possible without depending on wind; different fishing grounds can be covered within a short time; increase the fishing hours and bring the catches without spoilage. Mechanical fishing accessories like gurdies, winches etc. if provided to the boats would not only contribute to the fishing qualities of the boats but also make them suitable for operation of other modern gear and thereby increase the catch efficiency. This has to be taken as the next step in the development programme.

SHRIMP TRAWLING ALONG THE MALABAR COAST DURING THE YEARS 1955 AND 1956

By

A. T. SHARIFF

This paper brings out details of shrimp trawling survey made along the Malabar coast during 1955-56 and emphasises the importance of suitable mechanised boats and improved fishing gear to exploit fully the rich inshore grounds. It will be interesting to note that this survey was the first of its kind in India with trawls operated from small open mechanised boats and the good results achieved, so easily attracted the attention of the fishermen that they have begun to feel about their frail canoes and ineffective gears. It will not be very long, for the mechanised fishing to become very popular along this coast now.

Introduction

Shrimps (Prawns) form an important fishery on the Malabar Coast ranking among the first ten or twelve fisheries of the coast in quantity and value. The total catches made by the fishermen with their indigenous nets work out to about 1½ lakhs of maunds per year, valued at about 10—15 lakhs of rupees. They are caught from the littoral waters of the coast from May to December, the peak period being September to October. The experimental shrimp trawling operations conducted on this coast from Tanur to Mangalore, under the guidance of Mr. G. S. Illugason, F.A.O. Fishery Engineer have proved the existence of rich shrimp grounds along the Malabar Coast from December to April also. Thus it seems possible to get shrimps from the Malabar Coast almost throughout the year.

Description of Fishing Vessels Used

Danish boat—This boat was provided by F.A.O. It is 22 ft. in length, 7 ft. in beam, fitted with a 10 B.H.P. single cylinder, 2-stroke semi-diesel engine and reversible propeller. It is also fitted with a "Line Hauler" and a "Rail Roller" for hauling up the trawl wire. The boat is sturdy, built of Danish grown timber with a high flaring bow and cruiser type stern. It is light enough to be hauled up on the beach when harbours are not within easy reach. Its hull and propeller are well protected for beaching. This boat requires just four men to work and the engine is simple to handle consuming very low quantities of fuel, and it has been found very ideal for economically successful fishing.

M. V. Samudra—This is a real gill net wooden vessel allotted to Madras State under the T.C.M. Programme, length overall 10.40 M. Breadth, 3.35 M. Depth, 1.50 M. Draft, 2′ 2″ fore, and 4′ 2″ aft. Gross tonnage, 11.66. Total capacity, 30.029 C.M. Powered by 3 LD-G Yanmar Diesel engine of 42 B.H.P., 4 cycle vertical solid injection. There is one generator of 30 Amperes for lighting. Max. Speed 8.222 Knots, R.P.M. 800. Provided with an Echo sounder (Raytheon Junior Fathometer) and an insulated fish hold (1.2 M x 1.5 M) of 5 tons capacity. Crew accommodation for five; fuel storage 250 gallons and fresh water tank 100 gallons. The wheel house is well forward, with the engine bedded under it. The stern is broad and square providing enough working space. Deck machinery consists of a wooden roller 4 ft. long and 1 ft. in diameter fixed on the stern gunwale. This was removed and a small trawl winch provided by F.A.O. was fixed just behind the fish hold hatch. Each drum of the winch is capable of holding 100 fms. of 8 mm trawl wire. The main engine drives the winch through bevel gears. Two iron rollers were also fixed on the stern gunwale, each in a line with the centre of the winch drum.

Description of Trawls

No overhang or flat trawl nets of cotton were operated from both the Danish boat and M.V. Samudra. The net used for the Danish boat was 30 ft. by head rope, while Samudra operated the 40 ft. trawl. The nets were made up each of 13 pieces of netting. The square, belly, wings, jibs and throats were of webbings 10/15 threads and 2″ stretched mesh, while the cod end was of 10/42 threads and 1″ stretched mesh. The head rope was of Manila 1½″ in circumference with 10 cork floats for 30 ft. trawl and 14 cork floats for 40 ft. trawl. Each float was 6″ long and 2½″ in diameter. The foot rope was also of Manila 1½ ″in circumference with 17 lead weights for 30 ft. trawl and 23 for 40 ft. trawl. Each lead weight weighed 250 gms.

Otter Boards

Each board was made of 4 pieces of 5/8 thick hard wood 3.3/4 ft. long and 2 ft. broad strengthened on each side with a vertical ¼″ thick iron straps rivetted together through the wood. The lower edge of the board was of iron ¼ in. thick and 2 in. broad, rivetted on to the iron straps. Each board weighed 40 lbs. The iron brackets fixed to the board were 5/8 in. thick.

Each board used from Danish boat was made of 2 pieces of ¾ in. thick hard wood 42 in. × 21½ in. with 2 vertical ¼ in. × 1½ in. iron plates rivetted together. Iron brackets were 5/8 in. in diameter and the iron shoe ½ in. wide and 1 in. thick. Each board weighed 28 lbs.

Topography of the Coasts

The Beypore coast is low and sandy fringed with cocoanut trees—Kadalundi, Beypore, Kallai and Elathur rivers flow into the sea on this coast. A rocky patch lies on the south-eastern entrance of the Beypore river. Beypore river is the only river navigable throughout the year, the average depth over the bar being 6 ft. Rocky shoals also lie scattered off Calicut up to 4 miles from shore.

Tellicherry coast is of alternate cliffs with sandy beach, ringed with cocoanut trees. North of Tellicherry up to Cannanore the coast is fringed by rocks above and below water. Koodali, Anjarakandi and Valarapatanam rivers flow into the sea on this coast.

River Netravati flows into the sea on the Mangalore coast. Besides numerous small rivers flow in torrents during summer

The substratum of the above coasts is of thick mud.

Operation of Trawls

The length of the trawl wire paid out, was usually eight times the depth of water where the trawl was operated. The trawling speed was approximately 2½ knots in the case of "Samudra" and at 1½ knots the maximum towing power available in the Danish boat. The period of operations was usually from 5 A.M. to 3 P.M. when calm sea prevailed. By afternoons the winds blow from South-West and the sea became rough enough to make trawling difficult especially from the Danish boat.

Results

The exploratory trawling operations were initiated since January, 1955. At Tellicherry, the first centre selected, a 30 feet flat trawl was operated from the Danish boat in depths ranging from 6 to 10 fms. The catch was poor consisting of small sea breams, silver bellies and miscellaneous small fish. The operations were then shifted very close to the shore in depths from 1 to 3 fms., when good hauls of shrimps were made. The operations were continued till the end of April, 1955 in the same depths along the Tellicherry coast when nearly 11½ tons of shrimps and miscellaneous small fish were caught, fishing for 60 days only in a total of 203 hours which works out to 431.3 lbs. per day and 127.5 lbs. per hour. The fishermen believe that the shrimp

season last only from June to September, though small quantities of shrimps were caught in their bag seines (Kollivala) during January to April. "Kollivala" is a local boat seine with a head rope about 80 fms. long and ground rope 45 fms. The bag measures 40 fms. in length. The meshes vary from ¼ in. near the mouth to 1/32 in. near the cod end. Two stone sinkers are used on the ground rope of the wing. A coir webbing 10 fms. in length 7 fms. in breadth and 2 in. mesh, is joined to the ground rope. This net is operated from two dug out canoes and is carried in both the canoes with the bag between them. After reaching the ground the canoes move away from each other across the current paying the net. They then close the net along the current, stay for about 15 minutes and then haul up the net. The maximum catch in a "Kollivala" on the same ground off Tellicherry hauled by one unit of canoes during the period from the middle of January to April, 1955, but for 70 days only, was nearly 6½ tons of miscellaneous small fish and shrimps. The results of the Danish boat, therefore, which attracted the attention of fishermen, formed the foundation for an intensive survey of the coast line for shrimps from Beypore to Mangalore with the Danish boat and M. V. Samudra from January to April, 1956. Trawling for 72 days, actual fishing hours being 371 during the above period along the Beypore, Tellicherry and Mangalore coasts in depths from 1 to 5 fms. M. V. Samudra landed nearly 18 tons of shrimps and miscellaneous small fish making on an average of 6 hauls a day, each lasting either 40 minutes or an hour. Thus nearly 570 lbs. was the catch per day and 110 lbs. per hour on an average.

The Danish boat operating the 30 ft. trawl for 47 days during January to April, 1956 along the Beypore and Mangalore coasts in depths from 1 to 3 fms. landed nearly 9 tons of shrimps and miscellaneous small fish making on an average 5 hauls, each lasting either an hour or 40 minutes; 430 lbs. was, therefore, the catch per day and 93 lbs. an hour's catch.

The statement enclosed shows the details of results :

Discussion

The results of trawling proved the existence of potential shrimp grounds along the inshore belt in 1 to 5 fms. depth from Tanur to Mangalore during December to April and the possible existence of similar grounds which have not yet been trawled north of Mangalore and South of Tanur during the same period from January to April each year, when the fishermen consider it an off season for shrimps. The fact that the trawl alone makes good hauls of shrimps (nearly 75% of the total weight) as against poor catches of shrimps (nearly 35% of the total catch) in the fishermen's bag seines (Kollivalas) during January to April leads to the conclusion that a Kollivala which does not sweep the sea bottom well, becomes not very effective during January to April when the shrimps remain very close to the thick muddy bottom.

The results of "Samudra" from the statement enclosed clearly show that during January and February 1956, the catch per day along the Beypore coast was 313.1 lbs., during February to March 1956 along the Tellicherry coast was 553.0 lbs. per day and during March and April, 1956 along the Mangalore coast was 984.5 lbs. per day. Likewise the Danish boat catch increased from 366.6 lbs. per day during January and February 1956 along the Beypore coast to 503.1 lbs. per day during March and April, 1956 along the Mangalore coast. This may not, however, prove that shrimp grounds on the Mangalore coast are richer than the Beypore coast. Simultaneously fishing the different coasts during the same period will only confirm the existence of comparative richer grounds. The results of the Danish boat from the end of January to the end of April 1955 along the Tellicherry coast averaging to 431.31 lbs. per day, which is more than 366.6 lbs. per day obtained from January to February 1956 along the Beypore coast and less than 503.1 lbs. per day obtained from March to April 1956 along the Mangalore coast leads, however, to believe that the potentiality of the shrimp grounds along the whole Malabar coast increases from January to April each year.

Statement showing the details of results

Area Trawled	Name of the boat	Period fished	Gear used	No. of days fished	No. of Hours fished	Wt. of Shrimps	Wt. of other fish	Total catch in lbs.	Wt. of catch per day	Wt. of catch per hr.	Percentage of Shrimps catch
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Tellicherry Coast, lat. 11°30′ long 75°35′ to lat. 11°48.5′ long, 15° 23.2′.	Danish Boat	25th Jan. to 30th April, 1955.	30′ Flat Trawl of 2″ stretched mesh.	60	203	20,705	5,177	25,882	431·3	127·5	79·9
2. Do.	Two Canoes	Jan. to April, 1955.	Kollivala	70	300	3,880	7,320	11,200	160·0	37·3	34·6
3. Off Beypore and Chalyam	Danish Boat	1st Jan. to 21st Feb., 1956.	30′ Flat Trawl of 2″ stretched mesh.	24	150	6,248	2,552	8,800	366·6	58·6	71·0
4. Off Mangalore	Do.	21st March to 17th April 1956.	Do.	23	70	9,141	2,431	11,572	503·1	165·3	78·9
5. Beypore Coast lat. 11°0′ long. 75°49′ to lat. 11°18′ long 75°41·5′	Samudra	2nd Jan. to 4th Feb., 1956 and 13th Feb. to 17th Feb., 1956.	40 Flat Trawl of 2″ stretched mesh.	32	163	6,824	3,197	10,021	313·1	61·4	68·9
6. Tellicherry Coast, lat. 11°39′ long 75°30′ to lat. 11°52′ long 75°17′.	Do.	7th Feb. to 11th Feb., 1956 and 20th Feb. to 7th March, 1956.	Do.	20	106	8,185	2,876	11,061	553·0	104·3	73·9
7. Mangalore Coast lat. 12°46′ long 74°48′ to lat. 12°55′ long 74°46′.	Do.	20th March to 19th April, 1956.	Do.	20	102	16,145	3,545	19,690	984·5	193·0	82·3

SUGGESTIONS FOR PRESERVATION OF FISHING NETS

By

DR. H. MIYAMOTO

There are many causes which contribute to the weakening of vegetable fibres of fishing nets and ropes and they are fatigue by repeated load and shocks, abrasion due to continuous friction, sun light, fish slime and other physical and chemical effects. But, rotting due to the action of the cellulose eating bacteria is by far the most serious cause of damage to nets and ropes, particularly in tropical and sub-tropical regions with relatively high temperature and humidity. *Obviously, the best way to protect nets from rotting is to keep them always dry and store them in a cool environment with low humidity.* This may not always be practical. Preservation of the fibres against rotting therefore becomes necessary.

Experiments on preservation have been initiated at this Station and the findings of each will be published in the appropriate journals. The purpose of the present communication is to suggest a method of net preservation based on the deductions of experiments so far conducted.

Course of rotting of cotton and sun hemp twine

The course of rotting of untreated Cotton and Sun Hemp twines under continuous immersion in Cochin backwaters is indicated below :

Cotton No. 32, 3 *ply*, 18 *threads*

(Original breaking strength 8.1 kgms)

No. of days immersed	1	2	5	7	9	12	14	16	18
Percentage breaking strength to the number of days immersed.	100	98	77	59	46	20	6	2·5	0

Sun hemp twine No. 31, 7 *threads*

(Original breaking strength 25·1 kgms)

No. of days immersed	1	3	6	9	12	15	20	26
Percentage breaking strength to the number of days immersed.	100	91	53	23	15	6	1·6	0

It would be evident from the tables given above that within a few days of continuous immersion, twines lose their original breaking strength. This further substantiates the fact that untreated cotton and sun hemp nets and ropes never remain in water or in wet condition without considerable loss to its original breaking strength.

Suitability of tannin as a preservative

Cutch, Kalasam bark (Odina wodier), Panichikka (*Diospyros embryopterius*), Tamarind seed, myrobalan nut (*Terminalia sp.*), etc. whose main components is Tannin are some of the most popular preservatives used in India. It is well known that Tannin in itself is a poor preservative for nets and ropes. This fact is further evidenced in the tables given below :

Cotton twine No. 32, 3 *ply*, 18 *threads*

No. of days immersed	Percentage breaking strength of twines treated with preservatives*				
	Kalasam	Myrobalan nut	Panichikka	Cutch A	Cutch B
0	114	119	120	99	98
7	70	1·5	117	81	69
12	10	0	13	—	—
14	—	—	—	6·5	9·7
17	0	—	2	—	—
20	—	—	0	0	0

*Original breakings strength of untreated twine has been taken as 100%.

Sun hemp twines

No. of days immersed	Percentage breaking strength of twines treated with preservatives		
	Cutch	Kalasam bark	Panichikka
0	100	100	100
3	87	117	94
6	59	—	—
9	44	30	46
12	22	—	—
14	—	11	23
15	13	—	—

Tannin is easily soluble in water. Nets and ropes tanned, if exposed to water or kept wet even for a short period, the tannin dissolves away leaving only traces of the preservative. If, however, tannin can be fixed to vegetable fibres particularly cotton, its preservative qualities can be greatly improved. Fixing of tannin to the fibres can be accomplished by a process of oxidation. If tanning and dyeing are repeated many times, a certain percentage of the preservative is oxidized and adhere to the fibres. To accelerate this process, oxidising agents like Copper Sulphate or Pottassium bichromate are often used with beneficial results. But salts like copper sulphate have certain deleterious effects on the fibres if not used in the right way and in correct proportions.

Tannin with Coal tar

While certain workers (Firth and Carlson 1949) recommend coal tar as a simple and effective means of preservation for heavy nets, others (Whiteleather and Brown 1945) consider that coal tar should be avoided particularly in the tropics. In the experiments conducted at Cochin, although the commercial chemical preservatives like garnol, cuprionls etc., were found somewhat effective in their preservative qualities tannin mixed with coal tar was found to be most effective for preservation of cotton twines. A comparative statement of the life of cotton twines treated with coal tar mixed with indigenous preservatives is given in table below:

Cotton twine No. 32, 3 ply, 18 threads

No. of days immersed	Percentage breaking strength				
	Coal Tar	Myrobalan nut +C.T.	Panichikka +C.T.	Kalasam +C.T.	Cutch +C.T
0	104	91	89	86	79
14	50	76	88	81	87
24	—	—	—	84	85
28	42	57	94	—	—
36	41	57	98	90	90
50	17	20	92	81	lost
63	—	—	—	70	—

While the twines treated exclusively with coal tar did show a progressive decrease in its breaking strength during continuous immersion in water, those treated with Panichikka plus coal tar, Kalasam plus coal tar and Cutch plus coal tar keep their original breaking strength for nearly 36 days.

The following table will give the utility of the different preservatives on sun hemp twine :

Sun hemp twine No. 31, 6 *ply or* 7 *ply*

(Original Breaking Strength of each treated twine was taken as 100%).

No. of days immersed	Percentage Breaking Strength of sun hemp twine treated with preservatives					
	Net life green	Cuninine	Cutch +C.T.	Kalasam +C.T.	Coal tar	St. green cuprin.
0	100	100	100	100	100	100
9	102	119	109	89	88	74
17	69	96	81	73	44	56
27	38	38	44	58	20	27
37	19	10	18	41	7	32
47	20	11	17	34	0	20

Method of preservation recommended

Prepare a solution of tannin and dye the net following the usual method of treatment. The net is then dried and treated with coal tar mixed with 30% of kerosene. Dry the net in shade.

The above described method will be very useful for trawl net, Stake net and other types of gear which are immersed in water or kept wet for a long time. This method or preservation, is, however, not suitable for gill nets, cast net etc. as the weight of the treated twines increase considerably and the twines also become stiff.

Although the method described is not as effective on sun hemp as on cotton, it is definitely superior to the treatment of sun hemp by chemical preservatives.

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2. Whiteleather, Richard T., and Brown, Herbert H., 1945 "An experimental Fishery survey in Trinidad, Tombago and British Guiana with recommended improvements in Methods and Gear". Rept. of Anglo American Caribbean Comp. pp. 104-105.

PRELIMINARY INVESTIGATIONS ON THE PRESERVATION OF FISHING NETS

By

PRADIP TAGORE

Normally the drain in income from a fisherman's earning is attributed to the loss of nets. The two factors responsible for these losses are, (*i*) loss of gear due to unfortunate but natural circumstances like running over coral or gear torn by sharks etc., (*ii*) loss of gear due to deterioration caused by chemical and bacterial action. Except by mere luck or perhaps chemical and bacterial action. Except by mere luck or perhaps some skill or some presence of mind, the first type of loss cannot be avoided. But, it would be sheer foolishness on the part of any fishermen to neglect deterioration of gear from chemical and bacterial action which is a normal process.

Methods adopted so far may be classified as (*a*) Indigenous and (*b*) Scientific and no one method could be considered as superior to the other in so far as the practical application is concerned, because, while the Western countries are now using chemical methods because of the vast development of allied industries, the Eastern countries are still using their laborious but simple tan bark method which material is available in these countries not only in large quantities, but at a more economical price, than any of these bye-products of the chemical industry applicable to the preservation of gear.

As not much data is available except from what could be obtained from the local fishermen, it is the purpose of this paper to discuss the methods of preservation presently used by local fishermen with that of results obtained from a preliminary experiment being carried out in this Station to investigate the use of chemical methods for preserving gear.

In the West Coast of India, general types of preservatives in common use are the different types of barks, coal tar and copper containing compounds. The latter two methods are still in the embryo stage.

The two common barks used in the Bombay Coast are what are popularly known as Shammi and Ayana. The former is in use in Bombay city and its suburbs and to a very great extent in Colaba District, South of Bombay.

Methods—The bark is first dried in the sun for about four to five hours during which period it is continuously beaten by wooden hammers so as to soften the tissues. This ancient method helps in the maximum extraction of juice from the barks. After drying, the barks are kept in a wooden barrel in which water is poured forming the tanning solution. This solution remains in the barrel for about three days before a new net is immersed. Normally, for about every seven maunds of bark, 250 gallons of water is added. A new net is kept inside the barrel overnight and with the break of dawn it is taken out for sun drying, after which the net goes back again inside the barrel.

This process goes on between five to ten times till a dark brown hue is attained. The net is then ready for use after a few hours of drying. This net will be used for about ten to twelve days after which it is thoroughly cleaned in fresh water and treated repeating the same process as above.

Generally, the fishermen tan their nets twice a month irrespective of the fact whether it is old or new.

It is observed that during a fishing season of eight months, some 20 maunds of bark costing between Rs. 125—150 is consumed for tanning new nets. The cost of a

Dole net is from Rs. 750—1,000. The cost of tanning old nets is considerably less as only 7—10 maunds of bark is used for tanning purposes for the whole fishing season.

The second of the two very popular barks used is what is known as Ayana in the local language. The most striking contrast between the two methods of tanning is that while the previous method does not require the solution to be boiled in the latter, the solution is made in a vat and boiled for 12—14 hours. After the solution is boiled, it is removed from the fire and allowed to cool for a few hours after which the net is dipped. Here again, the net is kept inside the solution overnight and the same process as that used in Shammi bark is repeated. The process of dipping, drying etc. is continued for about 3 to 4 times by which time the net attains a very healthy and natural dark colour.

It is believed that the Ayana method of tanning reduces the cost of operation by 40% over the Shammi method. This method is predominant in the Thana District where it is available in abundance.

In most recent years, the current trend especially on the west has been to use coal tar products. Two methods normally used were the (*a*) Hot dip and (*b*) Cold dip; the latter is now in common use because of the elimination of fire hazards through inflammable solutions which make up the coal tar products. Through the kind courtesy of M/s. Standard Vacuum Oil Co., it was possible for this Station to investigate into the uses of a bituminous product called "Mobile Deck Coating Oil" which was supplied by them. The method used was cold dip process.

The manufacturers' report that in Queensland it was found that dipping the nets in a solution of two parts of Mobile Marine Deck Coating and one part of Laurel (lighting) Kerosene gave excellent results. After draining over the dipping through or drum the nets are hung up to dry. When dry, the nets run freely and hung correctly.

A modification is used in New South Wales. The lighting Kerosene diluent is replaced by Mineral Turpentine which gives quicker drying of the nets. To overcome a tendency for the bitumen to crack in use, the dipping mixture is plasticised by the addition of suitable plasticiser.

Results are reported to be superior to those formerly obtained from the old hot tar method of preservation with the added advantages of easier application and greater pliability of the treated nets.

In the beginning, the manufacturers advised us to use the solution without any dilution. In doing so, it was found that the texture of the twine became very hard as the solution failed to penetrate into the tissues of the fibre. Since then, we have made attempts by diluting the solution with kerosene oil and after varying dilutions, it was found that the best dilution was an equal amount of the solution with equal proportion of kerosene oil.

This solution was prepared in ordinary tin trays or empty drums and the solution stirred by a piece of bamboo or wood very steadily for about fifteen minutes by which time the required dilution is attained. The cotton net was then dipped in and kept inside for about five minutes after which it was dried in the sun for about one day before actual fishing operation. It was noticed that one dip in the solution kept the net for a very long time thus avoiding all the complications of periodical dips. Although the economies have not yet been studied, the result of our experiments indicated that the formal laborious process of re-dipping can be eliminated during the last one year, not more than one dip has been necessary for the twine at the same time maintaining the Breaking strength reasonably.

TITLES OF OTHER PAPERS PRESENTED

1. "Possibilities of Tuna Fishing in India"	By P. K. Eapen.
2. "A short note on the possibilities of shrimp exploration along the South-East and South-West Coast of India".	By A. T. Shariff.
3. "Suggestions for design of Otter trawl nets for small mechanised boats".	By H. Miyamoto.
4. "A short note on the hand driven net making machine".	By A. T. Shariff.
5. "Bottom set and Surface drift nets" ..	By S. Thyagarajan and S. Mahadevan.
6. "Method of net making and mending at Deep Sea Fishing Station, Bombay".	By J. L. Burroghs.
7. "Beam trawls for mechanised fishing craft".	Do.
8. "Results of operation with a triple Nylon gill net".	By A. I. George.
9. "Observations on operations with the fishing vessel "Champa".	Do.
10. "Lining and Trawling operations with "Sagar Kanti".	Do.
11. "Results of operations with Bangada"	Do.
12. "Modernising G.O.I. Deep Sea Fishing Fleet, Bombay".	By J. L. Burroughs.
13. "Investigations on Lobster Fisheries" ..	By H. Miyamoto and A.T. Shariff.
14. "Preliminary preservation experiments on coir twines."	Do.
15. "On the popularity of some net fishing in India"	By R. Balasubramanyan.

RECOMMENDATIONS

SUBJECT I

Fishing Gear and Methods

Gill Nets

(a) *Materials*

The B.S. varies from fibre to fibre. Experiments have to be conducted with various varieties of fibres available in the country as very little research has been done in this field from the fishing point of view. Central Fisheries Technological Research Station should take up intensive studies on the materials and their preservation.

(b) *Design*

Further work should be undertaken to assess the advantages and the various indigenous fibres used for gill nets. A proforma may be drawn for the collection of data from the different centres about the existing nets. Central Fisheries Technological Research Station should take up this work. Tackling the problem about Dara fishing in Bombay Coast to be intensified by the training centres in Bombay and Deep Sea Fishing Station, Bombay.

Trammel Nets

Systematic experiments to find out the relative advantages of trammel nets over ordinary gill nets may be conducted by the Government of India Deep Sea Fishing Station, Bombay and Cochin. The necessity of imposing control on the mesh size may be taken up after the experiments are over.

Mechanised Boats Vs. Non-Mechanised Boats

The work relating to the oceanographical conditions like current, drift etc. pertaining to the operation of gill nets may be taken up for investigations by the Research Vessel "Kalava" and the Government of India Deep Sea Fishnig Station, Bombay and Cochin.

Round Haul Nets

The programmes relating to the purse seines be further systematised. The available information about the working of the Indo-Norwegian Project boat may be communicated to other centres interested in the operation of the purse seines. The question of training groups of fishermen in the operation of purse seine may be taken up on a priority basis with the approval of the Standing Committee.

Trawls

Otter trawling was done in 1954 by the Government of India Vessels "Ashok" and "Pratap". Subsequent to that only bull trawling was being done by these vessels. It is, therefore, not wise to compare bull trawling and otter trawling because they were not done at the same time. In the Central Off-Shore Fishing Stations, the data about the relative merits are being gathered. It may be possible to indicate them after sometime. The work about the trawls may be taken up conjointly by the Off-Shore Fishing Station and the Indo-Norwegian Project.

Otter Boards

More data should be gathered through the training centres. The work may be taken up by the Central Fisheries Technological Research Station and a suitable proforma may be drawn up.

Beam Trawl

The experiments with the beam trawls may be further pursued by the Central Fisheries Technological Research Station and the Deep Sea Fishing Station, Bombay.

Mid-water Trawl

The experiments in the mid-water trawling may be intensified at the training centres and the Indo-Norwegian Project.

SUBJECT II

Deck Gear, Layout and Boats

Deck arrangements, deck equipment and layout will be done by the Indo-Norwegian Project, Off-Shore Fishing Station and the Central Fisheries Technological Research Station. Lay out of small boats will be done by the training centres, Indo-Norwegian Project and Central Fisheries Technological Research Station.

SUBJECT III

Gear Materials

Cotton : Synthetic Fibres
Wire Ropes and Combination Ropes

Ropes (Hemp, Manila and Sisal)

The tests about the different varieties of ropes may be conducted at the Central Fisheries Technological Research Station and the information passed on to other agencies.

Floats

The Central Fisheries Technological Research Station should get different types of floats like glass, thermocole, aluminium etc. and tests should be undertaken regarding buoyancy, durability etc.

SUBJECT IV

Manufacture, Maintenance and Preservation of Gears

Large quantities of tanning yielding barks and fruits are available in the country. These materials could be used profitably for preserving vegetable fibres. The Central Fisheries Technological Research Station should conduct detailed investigations on the tannin materials and the preservative methods.

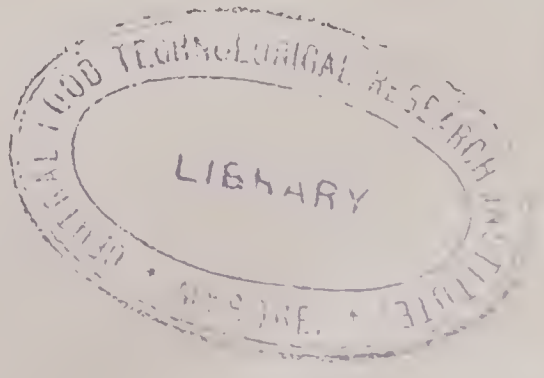
SUMMARY OF RECOMMENDATIONS

Research on various twines for gill nets will be conducted at the Central Fisheries Technological Research Station. Experiments on trammel net to be taken up by the Off-Shore Fishing Stations of Bombay and Cochin. Problems relating to dara fishing will be taken up by the Off-Shore Station, Bombay in association with the State Government Department. Information relating to the oceanographical conditions like current etc. will be collected by the Research vessel 'Kalava' and Off-Shore Fishing Stations in close association with Off-shore Fishing Units.

Training in purse seining will be taken up on a priority basis.

Regarding trawling experiments pertaining to efficiency of bull trawl and otter trawl these will be done by the Off-Shore Fishing Station, Cochin in close association with the Indo-Norwegian Project.

The investigations relating to the size and weight of otter boards the efficiency of various types of boats, power of boat etc., will be undertaken by the Central Fisheries Technological Research Station. The Training Centres will furnish information to the Central Fisheries Technological Research Station. Deck arrangements, deck equipment and layout will be done by the Indo-Norwegian Project, Off-Shore Fishing Station and the Central Fisheries Technological Research Station. Layout of small boats will be done by the Training Centres, Indo-Norwegian Project and Central Fisheries Technological Research Station. Regarding preservatives of vegetable fibres, manufacture of twines, ropes and other items, the work will be taken up by the Central Fisheries Technological Research Station.



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